THE
ELECTRICAL REVIEW.

VOL. LIII. JULY 3, 1903. No. 1,336.

"ELECTRICAL REVIEW."

Vol. LIII] CONTENTS: July 3, 1903. [No. 1,336.

	Page
A Technical University for London	1
The Electrical Conductivity of Copper (*continued*)	3
Legal	4
Parliamentary	6
L.C.C. Electric Tramways	11
Correspondence	11
Business Notes	12
The New Electricity Works of the Manchester Corporation (*illustrated*)...	18
The Royal Society Conversazione	22
Electricity Supply Accounts	28
City Notes	28
Stocks and Shares	30
Share List of Electrical Companies	31
Market Quotations	32
Electric Tramway and Railway Traffic Receipts	33
Automatic Electric Welder for Wire Hoops, &c. (*illustrated*) ...	33
The "Perfect Contact" System for Electric Traction (*illus.*) ...	33
The London Chamber of Commerce	34
L.C.C. Tramway Feeder Pillar (*illustrated*)	34
The Engineering Conference:—	
The Modern Equipment of Docks, with Special Reference to Hydraulic and Electric Appliances	35
Overhead and Other Railways	35
Gas Standards and Smoke Abatement	36
Steam Turbines	36
Petrol Motors for Locomotion	36
Gauges and Standards	36
The Position and Protection of the Third Rail on Electric Railways	37
The Fifth International Congress for Applied Chemistry, Berlin, June, 1903 (*concluded*)	37
South African Notes	39
British Industries and Foreign Competition	39
New Patents Applied For	40
Published Specifications	40

THE
UNIVERSAL ELECTRICAL DIRECTORY

1903 Edition

Price 10s. Post Free.

H. ALABASTER, GATEHOUSE & CO.,
4, Ludgate Hill, London, E.C.

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, AND HAS

BY FAR THE LARGEST CIRCULATION
of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can now be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street, Paris: VEUVE J. BOYVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

A TECHNICAL UNIVERSITY FOR LONDON.

THE letter which Lord Rosebery has been enabled to write to Lord Monkswell, who, as Chairman of the London County Council, is titular head of the metropolitan authority for technical education, makes an offer which, if accepted, should be of almost incalculable advantage to the Metropolis, to the United Kingdom, and even to the British Empire. Briefly, Messrs. Wernher, Beit & Co. and certain other London philanthropists, who at present prefer to conceal their identity, offer to place a sum of £300,000 in the hands of trustees for the erection and equipment of a higher technical school to be attached to the University of London, provided a site can be found for the buildings; while Lord Rosebery believes that the Royal Commissioners of the 1851 Exhibition may be willing to grant a site of about 4 acres of land adjacent to the present University buildings at South Kensington, which is estimated to be worth £200,000. Thus a capital sum of half a million for the endowment of technical education is virtually offered to the nation, with the solitary proviso that the funds necessary for maintenance, now estimated at £20,000 per annum, shall be forthcoming. And it is to ask the London County Council for a promise of this annual sum that Lord Rosebery has written his letter to Lord Monkswell.

In many respects the letter itself, and the state of public feeling which it illustrates, are so gratifying as to be almost surprising. For years the lay press has been proclaiming that technical education is the one thing necessary to our commercial salvation; but, wholly misunderstanding the problems of modern industry, it has been preaching that variety of technical instruction which leads to an amateurish and superficial acquaintance with the processes of particular trades. Some authorities and some benevolent men have been misled, and numerous institutions have been created or have started evening classes to provide this sloppy kind of teaching. For years also deeper thinkers and the technical press have cried out at this waste of energy, arguing that real technical education means the higher and more lengthy training in pure and applied science of those men who are to become works' managers or technical consultants; but hitherto their voices have seemed to be of none effect. Suddenly, however, a change has come. Lord Rosebery, whose opinions and utterances on all public matters carry great weight with every thoughtful Englishman, and who is recognised even by his responsible political opponents to be a statesman, has spoken out plainly, asserting that "several of our industries have suffered, and are still suffering, from our failure to organise, not so much technical education of the ordinary type as the more advanced instruction in scientific technology and facilities for original research." Several of the arguments and illustrations used by Lord Rosebery are taken from the report of the special Sub-Committee of

the Technical Education Board of the London County Council, which was published a year ago. Their report fell rather flat, in spite of the value of its contents; but this was not altogether surprising, for it is still matter of argument whether the L.C.C. has always acted for the best in its numerous enterprises, and we are none of us too disposed to review our opinions when once they have taken an unfavourable character.

We have no need here to describe the details of Lord Rosebery's proposal: our readers have all studied his letter, and the comments made thereon by the superior daily Press. It is only because we are in a better position than the ordinary non-technical journalist to appreciate the enormous benefit to the nation of a suitably modified London "Charlottenburg," that we refer to any of the objections and difficulties. In the first place, £20,000 per annum will not be sufficient to maintain an institution worthy of the Metropolis—very far from sufficient if, as Lord Rosebery hopes, the fees are to be kept low. Secondly, the London ratepayer has to be considered; and it does not appear altogether just for him to be called upon to provide practically all the maintenance of a Technical University which will be national in its scope. These, however, are matters of finance, which we leave to abler pens; but there remains another point which is perhaps even more important. A London Charlottenburg, even if perfect in *personnel* and material equipment, will but languish unless our manufacturers can be taught the advantage of employing properly trained managers and experts in their factories and workshops—unless, that is to say, they are prepared to support the institution by finding positions for such of its students as deserve them.

Lord Rosebery, we regret to see, is somewhat disposed to lay excessive stress on the superior educational facilities of the German and American Universities. To a certain limited extent it must, we fear, be conceded that the student (of average ability) who has studied for so many years abroad is of more immediate value in shop or works than the Englishman of equal length of training. But the superiority of the former depends very little, if at all, on his greater scientific ability; he is more useful, because his residence in a foreign country has aged him mentally. We speak from personal experience; we know that a year in a good laboratory here is precisely equal to a year in Germany—technically, that is; but we know that in all non-technical directions the year abroad is better; and we have found out that it is a more valuable commercial asset (all degrees or diplomas excepted). Thus while "Charlottenburg" remains in Germany, it is actually (intrinsically but not scientifically) better than a British training college; and to the journalist it is perfection. But were its twin founded in London, it would lose its real superiority, and the journalist would proclaim it grossly inferior to (say) Zürich. If, as we sincerely trust may be the case, the London Charlottenburg takes material shape, we may find many of its students Germans; and eventually, as its value becomes more evident, we may be led to provide a larger proportion of the students at Berlin than we do at present. This will benefit us, but the advantages to Germany will be sensibly equal.

The true reason why manufacturers find foreigners more useful in their factories than home-trained students, is because the former have usually undergone a more prolonged course of study; so that they have not merely mastered the routine and established part of their subject, but have acquired a taste for, and a facility in carrying out, original work. It is idle to expect a youth to devote the best years of his early manhood to hard mental study, or his father to provide the necessary money, if another lad who is less able, and who has only ordinary intelligence, can earn equal or higher wages as a clerk or cashier. The young curate may die Primate of All England, the doctor a wealthy and respected peer; the young electrician or chemist has a far smaller chance of achieving mundane success or celebrity outside his own circle than his brother in the bank. The real difficulty at the present time is not so much to find men trained highly enough to merit large salaries and probably to bear heavy responsibility, as to find posts and adequate salaries for such. It is said that much poverty and distress exists in Germany among highly-trained men; but the extreme difficulty experienced by young Englishmen of scientific training in finding any post at all, the numbers of them who are out of work, or who have had to cast aside their special knowledge, is saddening to contemplate. They have no banners and collecting boxes and processions to bring their troubles into prominence.

And therefore it is, while welcoming Lord Rosebery's letter, and being deeply thankful for the munificence of the donors of the money, that we feel a desire to see symptoms among the industrial magnates of the land of an awakening recognition of the money value of science. A chemist or electrician is of more use in the country than a dock labourer; but if both are unemployed, with which does the advantage lie? Mr. A. G. Green, speaking of the coal tar dye trade only, has summed up the position epigrammatically but fairly in the words, "The English manufacturer has considered that a knowledge of the benzol market was of greater importance than a knowledge of the benzol theory," and in consequence the industry is nearly dead.

As a matter of policy, it is, perhaps, somewhat unfortunate that Lord Rosebery's scheme should have been made public on the very day selected for the inauguration of the Bessemer Memorial Fund. To the man in the street and the student of the halfpenny press, this coincidence may give the appearance of clashing of divergent interests, or of the operations of two bodies of men working in the dark. Unfortunately, this notion will be rather strengthened by a complaint made by an earlier speaker at the Bessemer meeting, to the effect that the City of London had been ignored by Lord Rosebery. There is no need, and, we trust, little fear, that the two schemes will overlap; in fact, the Bessemer memorial aptly takes the form of one or two departments of the new Technical University. Admirers of Bessemer's work, and they should be found in every country where steel is known, who desire to contribute to the fund, and so to pay back a trifle of the debt we all owe to him, could find no better opportunity of having their moneys used to the best advantage, than in assisting to endow the metallurgical and mining faculties of the proposed University, faculties which might well be called the Bessemer, and, as Sir J. Wolfe-Barry suggested, the Mushet, Schools; and also in the establishment of Bessemer and Mushet scholarships.

Nothing can be further from our intention than by anything we have written to minimise the vast importance of the two schemes now before the country. But those of us who know how ably our professors can train their students, and how perfectly the British student can assimilate scientific training when the necessary funds are forthcoming, when the necessary time is available, and when the necessary incentives are present, are apt to become restive when all the blame of imperfect technical ability is laid at the door of the students and the teachers. It is not fair to do so, when our manufacturers and capitalists have acted as they have in the great majority of cases; and therefore the success or failure of Lord Rosebery's University

will depend quite as much on the support given it by those manufacturers in the erection and maintenance of works' laboratories, as upon the L.C.C. in providing the actual funds for carrying on the good work.

Darlington's Folly.

SOME few months ago, as our readers will recollect, chaos reigned supreme in the plans for the many tube schemes with which energetic promoters were prepared to deluge our benighted capital, for the improvement of its notoriously inefficient local intercommunication. That the condition of affairs, where every promoter pleased himself as to ways and means, was utterly bad, will be gathered from the fact that a Select Committee was appointed with a view to exercising a certain amount of control in the matter.

To those who consider the future of interurban tramways in the far more important sphere represented by the rest of Great Britain, there has appeared to be an urgent necessity for some control on a similar basis, at least in the matter of gauge. In far too many instances adjoining authorities have adopted dissimilar gauges, from so-called local restrictions, freely intermixed with a "feeling" that they were safeguarding their preserves from the inroads of neighbouring and rival tramways. And this is just where we are convinced they have erred, probably greatly to the detriment of their pockets, and what is of far more importance, to the great disadvantage of the travelling and trading population whose interests the tramways are primarily intended to serve.

Our attention has been drawn to the more than usually flagrant decision of the Darlington Tramways Committee, who recently met in conclave to decide as to whether a difference of 1 in., which existed between the specifications for their tramway track about to be constructed, and the existing track of the Imperial Tramways Co. running through Middlesbrough and Stockton, should be abolished. Needless to add, these local wiseacres have agreed to adopt the different gauge, though it be but the small amount of 1 in. It would probably have been the same had only a fraction of an inch entered into the question. In a busy manufacturing, coal and iron producing, shipping and trading district, such as the one in question, there can be no excuse for the multiplication of gauges, which must in the long run tell heavily against the utility and convenience of the growing networks of interurban tramways. These, it must be remembered, will inevitably carry a large share, not only of passenger traffic, but also of many classes of merchandise, which can be handled thus, over short distances, far more cheaply and expeditiously than in any other way.

The latter phase of tramway work is rapidly coming to the fore, and as soon as our little local governments shall agree to sink their paltry differences and grasp the broad questions of the general welfare of the travelling and trading community in their district, as distinct from their own comparatively small domain, so soon shall they have justified theirs.

The examples of neighbouring municipalities adopting their own particular gauges are so numerous, that their recital would occupy more room than our limited space will allow. The cases of Leeds, Bradford, and Halifax, with their 4 ft. 8½ in., 4 ft., and 3 ft. 6 in. tracks meeting each other are well known, and the case of Wigan with its 3 ft. 6 in. gauge isolating itself from the standard 4 ft. 8½ in. tramway networks of South Lancashire, is a more recent example of municipal shortsightedness. Compared with these cases, however, the decision formed by the Darlington Tramways Committee is a masterpiece of imbecility, and surely represents the utmost limit of municipal mismanagement.

THE ELECTRICAL CONDUCTIVITY OF COPPER.

BY ROLLO APPLEYARD, A.M.INST.C.E.

(*Continued from Vol.* 52, *page* 1067.)

FROM any pair of values of τ and θ, chosen from the "observed" figures, and the corresponding pair of resistances, we can, from this last equation, calculate a value for $\log\left(\frac{R_1}{R}\right)$; the question is, which pair will result in a logarithmic curve to conform most nearly to the "observed" curve? Unfortunately, Messrs. Clark, Forde & Taylor do not appear to have published their "observed" figures, though they mark some of them on the "observed" curve. We must, therefore, assume that their parabolic formula accurately represents the "observed" results, and we must calculate the resistances R_τ, R_θ therefrom. It is instructive to compare these derived figures in tabular form, for increments of 10° F. at successive intervals of 5° F. as follows:—

τ	θ	$\tau-\theta$	R_τ	R_θ	$\frac{\log R_\tau - \log R_\theta}{\tau-\theta}$		$\frac{R_\tau - R_\theta}{\tau-\theta}$	
42	32	10	1·02374	1·00000	0·0010190	102	0·002374	4
47	37	10	1·03564	1·01186	0·0010088	103	0·002378	3
52	42	10	1·04755	1·02374	0·0009985	97	0·002381	4
57	47	10	1·05949	1·03564	0·0009888	99	0·002385	3
62	52	10	1·07143	1·04755	0·0009789	97	0·002388	3
67	57	10	1·08340	1·05949	0·0009692	91	0·002391	4
72	62	10	1·09538	1·07143	0·0009601	89	0·002395	4
77	67	10	1·10739	1·08340	0·0009512	92	0·002399	3
82	72	10	1·11940	1·09538	0·0009420	89	0·002402	3
87	77	10	1·13144	1·10739	0·0009331	84	0·002405	4
92	82	10	1·14349	1·11940	0·0009247	86	0·002409	3
97	87	10	1·15556	1·13144	0·0009161	81	0·002412	4
102	92	10	1·16765	1·14349	0·0009080		0·002416	

Assuming the accuracy of Messrs. Clark, Forde & Taylor's observed values as plotted on their curve, this table shows (1) that the linear temperature coefficient increases almost uniformly with temperature. (2) That the logarithmic coefficient decreases with temperature at a diminishing rate. (3) That the old values 1·0020935 and 0·0009083 given in reduction tables for the linear and logarithmic coefficients, respectively, at 75° F., are, for present-day high-conductivity copper, incorrect. (4) That the difference between the mean and extreme values of the logarithmic coefficient from 32° F. to 102° F. is about 6 per cent. (5) That the difference between the mean and extreme values of the linear coefficient from 32° F. to 102° F., is less than 1 per cent.

In seeking now a definition free from ambiguity, with these points cleared up, let us, in order to realise the further difficulties, make the (false) assumption that conductivity varies directly as the density of the copper. Also, let us agree that the nearest value to the mean density of copper is 8·9, at, say, 60° F. According to this assumption let the resistance of a copper wire of length l ft., of weight w grains, and of relative density 8·9, be, say,

$$R_0 = \frac{l^2 \times 0{\cdot}2162}{w} \text{ standard ohms at } 60° \text{ F.}$$

From equation (1)

$$R_0 = \frac{l^2 k \Delta_0}{100\, w}.$$

Hence,

$$\frac{k}{100} = \frac{0{\cdot}2162}{\Delta_0}. \qquad (4)$$

From equation (1) it also follows that any other copper wire, of different density Δ_1, will also have 100 per cent. conductivity if its resistance is represented by—

$$R_1 = \frac{l^2}{w} \cdot \frac{k\ \Delta_1}{100}. \qquad (5)$$

But it will have different sectional area and different specific resistance. Combining (4) and (5)

$$R_1 = \frac{l^2}{w} \cdot \frac{0{\cdot}2162}{\Delta_0} = \frac{l^2}{w} \cdot \frac{0{\cdot}2162\ \Delta_1}{8{\cdot}9}.$$

For example, let $\Delta_1 = 8{\cdot}912$, which is the density assumed for all copper, annealed or hard-drawn, by the Committee of Experts and Manufacturers. The resistance of a wire of this density, and of 100 per cent. conductivity, if calculated from this last equation, is—

$$R_1 = \frac{l^2 \times 0\ 2162}{w} \times \frac{8{\cdot}912}{8\ 9} = \frac{l^2 \times 0{\cdot}2165}{w}.$$

For annealed copper the multiplier for $\frac{l^2}{w}$ given by the above-mentioned Committee, works out at 0·216226, and for hard-drawn copper at 0·220581. On our present assumption the corresponding derived percentage conductivities appear as—

$$\frac{100 \times 0{\cdot}2165}{0{\cdot}216226} = 100{\cdot}12 \text{ per cent. (for annealed copper)}$$

and as

$$\frac{100 \times 0{\cdot}2165}{0{\cdot}220581} = 98{\cdot}15 \text{ per cent. (for hard-drawn copper).}$$

It therefore leads to very fair seeming results. The method of correction would be of ready application, and it is plausible. Nevertheless it involves the fallacy that percentage conductivity varies directly as the density, and thereby stands condemned; for experiment shows that conductivity does not vary as the density.

In connection with the results just obtained, it is interesting to note that when Matthiessen took the conductivity of silver at 100 per cent., he found 102 21 per cent. for annealed copper, and 99·95 per cent for hard-drawn copper of his day; a difference of about 2¼ per cent. against our 2 per cent. (See *Trans.* R.S, Vol. 154, 1864, p. 197.)

Having now surveyed the sources of uncertainty and error, which for so long have enshrouded this fugitive quantity, how can we best direct our way towards a rational system? In seeking an answer to this question, it must be remembered that percentage-conductivity is with us to stay. It is printed as a cardinal clause in specifications, British and foreign, for submarine cables, and for railway wires. Changeful in itself, it belongs to things immutable. As a determinant of the quality of bulk copper, it is as important to the cable-maker as is the permeability-test to the maker of dynamos. Its convenience is well illustrated by the fact that its very errors appear as direct percentages, as lucidly as a fall in stocks. Hence we ought not to discard it and fall back upon specific resistance without due consideration of what would be renounced. It is conceivable that convention could establish a percentage system of specific resistances to replace conductivity-percentages. But there would be this fatal objection to it, that *diameters* would then probably be specified, and they would have to be determined instead of *weights*—by commercial methods—a far less precise operation. Thus practical errors of measurement would replace theoretical errors of definition, and we should dislocate our system to no purpose.

Now, if the accurate determination of the mean diameter of a wire by commercial methods, *i.e.*, by the micrometer gauge, is impossible, nevertheless, the volumetric method of the laboratory, though slow, is, when properly carried out, very sure. This suggests that although we cannot for every-day purposes admit the slow volumetric method into the workshop, we can appeal to it in the laboratory in the event of any dispute or of any alleged breach of contract. In all but these rare cases, a difference in percentage-conductivity of plus or minus 0·56 may, without consequence, be neglected. Specific resistance has the advantage of being independent of density, for it is defined in terms of length and sectional area, not of mass. What it comes to then is this: We can establish our *standard* of percentage-conductivity as the reciprocal of a standard specific resistance agreed upon by convention. In cases of dispute we can then always fall back upon this proposed conventional relationship between specific resistance and percentage-conductivity, and refer the matter to the laboratory for a test of the specific resistance. Meanwhile, in the workshop we can carry on with the *weight* method; or we can use the micrometer. Existing stereotyped specifications would thus require no modification whatever in respect to their conductivity clauses. The decisions of the Committee of Experts and Manufacturers would also hold good, without modification, for, as has been shown above, their decisions are not affected by the particular value we may choose as a standard of 100 per cent. conductivity; and ambiguity would vanish. To attain this result, convention must—

1. Decide what figure to take for the specific resistance, which, at standard temperature, shall correspond to 100 per cent. conductivity.

2. Agree that it shall be proper to deduce from the reciprocal of that figure the percentage conductivity corresponding to any other specific resistance, by direct proportion.

3. Decide as to the temperature correction to apply to copper.

In regard to (1), if we start with the foot-grain formula suggested above, and if for the moment we assume the density of copper to be 8·9, then since 1 gramme = 15·432 grains, and 1 ft. = 30 4801 cms., the *specific resistance of copper of 100 per cent. conductivity* would be

$$\frac{0\ 2162}{15{\cdot}432 \times 8{\cdot}9 \times 30{\cdot}4801 \times 30{\cdot}4801}$$

= 0 0000016944 standard ohm at 60° F.

The reciprocal of this is 590,187, which would be the standard conductivity of 100 per cent. referred to unit centimetre cube at 60° F. It should be noted that the only object of introducing the density term in the above expression is to arrive at a conventional figure for the centimetre cube datum. When this is once determined, the question of density has nothing further to do with the matter. It is, in fact, wrapped up in the workshop margin of 0·56 per cent. Neither the figure 0·0000016944, nor its formidable reciprocal 590,187, would ever enter the workshop. They would be restricted to the laboratory.

(To be concluded.)

LEGAL.

Patent Exploitation, Ltd., v. The American Electrical Novelty and Manufacturing Co., Ltd.

(*Continued from Vol. 52, page* 1073.)

Mr. James Swinburne, further cross-examined by Mr. Astbury:

At all events, in the Gassner, as made, the description I have read to you from Mr. Cooper's book is a fair description of the Gassner cell, which was the first successful dry cell to be put upon the market?—If it is in his book, I have no doubt it is all right. I do not know that without knowledge.

In the Gassner specification you do not find the space between the two poles filled up with layers of materials made according to the plaintiffs' directions?—No.

Have you ever known before this case of soft agglomerates being talked of in the market?—No.

Were the agglomerates of manganese and carbon well known in the market always perfectly hard?—Yes.

It is probably owing to their being hard and solid that Mr. Cooper says on page 218 that these agglomerate blocks as known were used without any very great success?—I think so. I think they are hard and solid, and not very good conductors.

You know that that again is another instance where you were asked and answered that electrically the Hellesen is the same as the plaintiffs. That means no more than that electrically the plaintiffs' is the same as the wet Leclanché?—Yes.

In Bender there is no provision for making the manganese and carbon which surrounds the negative pole into a paste or anything of that kind?—It is crushed retort carbon and manganese oxide.

You are simply directed to put it into the space?—Yes.

And there is no direction that that shall be mixed with an excitant at all before it is put in or as it is put in?—No, that does not make any difference.

The internal arrangement of the hollow pole is totally different from anything in the plaintiffs'?—Yes.

Bender you see is 1888. Did you ever hear of Bender's battery being put on the market?—Never.

And whether in your opinion the differences are large or small, a battery made according to Bender would be commercially a very different article to the plaintiffs'—take the E.C.C. battery, for instance?—It would not be so good as the E.C.C. It would be a more expensive battery, because you have got an unnecessary thing down the middle, but as far as the two layers go it is the same, except that there is coarseness here and fineness in yours.

It has not got an inner layer composed of pulverised insoluable materials?—No.

And if that is one of the principal features contributing to the plaintiffs' success, Bender lacks it?—It lacks the pulverisation.

There are several small commercial differences between this and the plaintiffs' battery?—Quite so.

I observe it is not even referred to in Mr. Cooper's book as a dry battery which was known?—Very likely.

Skrivanov is again one of those sandwich batteries?—Yes.

And the problem that this man was attacking in making this particular sandwich battery was a totally different problem from that attacked by Hitchcock?—I do not know quite what you mean.

This is not a commercial ironmonger's battery is it?—No. What this man is inventing is a new kind of mercury depolariser. That is the point of his invention. The other is all common knowledge, only he happens to put it in there, and so we have cited it.

Whether it is important or not, this Skrivanov battery would not commercially answer hardly any of the features which Hitchcock's battery does answer?—It may be it would not. As made for the purpose of commercial use, it would be better, but still it would be too expensive. It is not a battery which would rival this Leclanché form.

This dry Leclanché?—Any of the Leclanché forms.

Nobody thought it worth while to refer to Walker in the last case. He says, "The object of my invention is to construct portable electric batteries by means of rendering excitant into a paste." Then he says: "The positive element may consist of zinc, lead, or iron, or any alloy of the two former with tin." Now, supposing you used iron for a moment as your positive pole, and put this strong sulphuric acid in, of specific gravity 1390, it would soon lead to disaster, would it not?—Yes; the oat and pea flour would have a bad time, too. It would act on them.

Have you noticed that it is only a provisional specification?—Yes.

Nobody seems to have thought it worth while to proceed further with it. You do not know the complete specification of this patent?—No.

It has never led to anything that you ever heard of?—No; it shows that the man had the idea of making a dry Leclanché cell. It shows that very clearly.

Could you have a Leclanché battery made with muriate of ammonia and sulphuric acid of 48 per cent. strength?—No.

That is mixed with gypsum, oat, wheat or pea flour or lime. Supposing you put in lime; the result would be appalling?—Yes.

Supposing that you used manganese for your pole in the agglomerate form that you have talked about, which, you say, he does not say you are to bake, would the sulphuric acid of 48 per cent. strength destroy the whole of the outer layer of the manganese on the pole?—The sulphuric acid would practically destroy everything in that battery.

Do you think anybody from this document would learn how to make an E.C.C. battery?—No; what a person would learn would be that the idea of making an exciting paste was perfectly old.

I should think what a person would learn would be to avoid making a dry battery?—Anyone with sense could avoid making a dry battery according to these instructions.

Anybody with any sense who read this specification would put it aside and try to get something better?—Anyone with any sense could make all these batteries without reading these specifications.

Anybody with any sense who read this specification would put it aside as rubbish?—Yes.

Take Webb and Jensen. This is the one where the chemistry on page 3 is a little wrong. He is going to have air circulation by pieces of pith through the paste, and things of that sort?—Yes. He puts yeast in and baking powder.

There is no suggestion here of making a battery in any way like the plaintiffs' prescription?—No, this would be an acid battery. It is not a Leclanché battery.

You mean if it was made in such a way as to be a battery at all?—If it was made by following this, if you made anything at all you would get an acid dry battery.

Take Hartmann and Braun. There is no provision at all for making the outer layer with a hygroscopic?—I have only to deal with the document. It does make a hygroscopic through a fault of its own, the bleaching powder. I have not tried it, but I have no doubt the bleaching powder would act on the zinc and make chloride of calcium and chloride of zinc. He ought not to have put any bleaching powder into that battery.

In the centre he puts peroxide of lead, permanganate of potash, and chloride of lime?—Permanganate of potash and chloride of lime are again wrong.

As far as this document is concerned, do you think it is a very hopeful production?—No.

For the purpose of keeping the powdered manganese from getting to the zinc, will the blotting paper act exactly as efficiently in the defendants' as the plaster of paris and the flour act in the plaintiffs'?—Yes, with stuff of this size, certainly.

With the exception that blotting paper is substituted for plaster of paris and flour in the outer layer, and that the materials in the inner layer contain less moisture, and are much more tightly packed. Do you see any difference between the defendants' battery and a battery made according to Hitchcock's directions?—You are putting an interpretation on the word "pulverised." If the word pulverised means exceedingly finely powdered, then Hitchcock has not got that. If it means simply powdered to the extent of those three bottles, then the only difference is blotting paper instead of the other paste and light ramming.

Supposing "pulverised" means made sufficiently small so that you could mix it with water, and make a semi-solid mass which will hold up the water by capillary attraction?—Leaving out the word semi-solid. If you make it so that it will hold up the water.

No. I put it in purposely. Supposing you make your manganese or carbon sufficiently pulverised so that you can mix them with water and make a semi-solid mass, that will hold up the water by capillary action. If that is the meaning of pulverised, then is there any difference between the two?—If the term semi-solid is a right description for that sort of consistency there is no difference as regards that. There would then simply be the difference of the blotting paper as opposed to the paste.

Your view is that you get a degree of further improvement by extra ramming of your inside mass, which results in less moisture?—Yes. Less moisture is the incidental result. The real result is better conductivity.

You think the defendants ram theirs tighter than an ordinary person reading Hitchcock would be inclined to do?—Certainly.

With that exception, is there any difference between the two batteries except that the defendants used blotting paper in the place of plaster of paris and flour?—That and the powder—those three things.

Mr. Justice Buckley: What are the three?—There is the fine powder, and the ramming and the blotting paper.

Mr. Justice Buckley: Fine powder and blotting paper are the same thing in a different form, are they not?—No. Fine powder is as regards the inner layer. There is a difference in using blotting paper and the plastic semi-solid material described in the particular description.

Are the only functions played by the plaster of paris and the flour in the plaintiffs' battery, enabling the battery to be a dry battery; secondly, enabling the water to freely permeate the mass; and thirdly, preventing the insoluble powdered manganese from getting to the zinc?—Yes.

And making good contact with the zinc?—I took that as part of it.

There is, first, making the battery a dry battery; second, allowing the moisture to freely permeate; third, preventing the solid powder getting to the zinc; fourth, maintenance of good contact with the zinc; and I think I ought to say, fifth, that it must be non-perishable by the action of the battery?—Yes.

Is every one of those functions performed by the outer layer of the defendants?—Yes.

You told his Lordship that, in your view, this light running of the defendants led to greater success?—Yes.

Should I be fair in saying that the least reasonable outside resistance that these batteries are put to would be 5 ohms—say to ring an ordinary bell?—I should think 10 ohms or 5 ohms.

If the battery is doing no work, in your view, the light running, as against the packing of the plaintiffs', if there is a difference, produces greater conductivity?—Yes.

And, therefore, less internal resistance?—Yes.

I put it to you, the moment you put it on a circuit with a resistance of 5 ohms the two are absolutely identical in results. The defendants' give no better results than the plaintiffs', made according to plaintiffs' limited description?—I should think that was so.

You have not tried it?—No. You must not put it on at the moment. You must leave it or test it through the whole use of the cell.

It is quite obvious, is it not, that the distinction of extra conductivity, and less internal resistance, would tend to be obliterated as you put it on to an outside resistance?—Yes, the bigger the outside resistance.

Do you think it fair to take 5 ohms as the least ordinary outside resistance upon which they would be put to work?—I think so.

The further hearing was adjourned.

(To be continued.)

National Telephone Co., Ltd., v. Corporation of Kingston-upon-Hull.

On Saturday Mr. Justice Buckley, in the Chancery Division of the High Court of Justice, delivered his reserved judgment in this case, which raised an important point as to the position of local authorities under the Telegraph Act of 1899, empowering the Postmaster-General to license such authorities to lay down and work telephone systems.

His Lordship said that by the Telegraph Act of 1863, authority was given to certain companies to place and maintain telegraphs under any street or public road, subject to a restriction that they should not do so within the district of any city, or municipal borough or town, having a population of 30,000 inhabitants or upwards, except with the consent of the bodies having control of the streets. That Act applied only to companies authorised by special Act of Parliament, and the plaintiff company was not such a company. By the Telegraph Act, 1868, authority was given to the Postmaster-General to work telegraphs in connection with the Post Office. The Postmaster-General thus acquired the power, in Section 6 of the Act, to lay telegraphs under streets, but subject to the restriction of Section 9, which required the consent of the road authority. By the Telegraph Act of 1869, Section 4, the Postmaster-General obtained a monopoly in the transmission of telegrams except as by that Act provided, and telegraph and telegrams were by Section 3 so defined as to include telephonic communication. In November, 1884, by a deed made

between the Postmaster-General and the plaintiff company, the Postmaster-General, in the exercise of his powers to grant licenses, granted to the company for 31 years, expiring in December, 1911, a licence and permission to work and use telephones. Under that authority, the plaintiff company laid down trunk and other lines, and established telephonic undertakings. By an agreement of November 10th, 1897, the Corporation consented to the company exercising their powers as licensees under the Telegraph Act of 1892, but subject to a proviso that as regarded underground work the company should not execute without first applying to the Corporation for their consent. The result was that the company had obtained the Corporation's consent as to overhead works, but a further consent was required as to underground works. By a further agreement made in March, 1899, between the Corporation and the company, the Corporation gave leave to lay down certain underground works, but subject to a proviso that the Corporation might, after passing a special resolution, and hearing the company, if the company required to be heard at any time, determine the agreement by six months' written notice, at the expiry of which the company was to remove the wires. His Lordship held that this power to determine could be rightly imposed as a condition under Sec. 5 of the Act of 1892. On March 23rd, 1899, the Postmaster-General, under Sec. 5 of the Act of 1892, and in accordance with a deed of March 25th, 1896, authorised the company to exercise within this urban district the powers of executing works conferred upon him by the Act of 1862, but subject to the deed of 1896 and the Acts of 1863 and 1897. Under the authority of the agreement of March 18th, 1899, and the license of March 23rd, 1899, the company between March and August, 1899, laid down a number of underground pipes in Hull. In August, 1899, the Bill which became the Telegraph Act, 1899 was approaching its final stage, and the Corporation became alarmed, in his Lordship's opinion unnecessarily, by a clause which it was at a late moment proposed to introduce, and which became Section 3 of that Act. Apparently they thought that if the Act passed without their giving a notice to determine the agreement of March 18th, 1899, they would have no subsequent power of determination. Accordingly the Corporation sent the company notice of a special resolution to exercise the power of determination. The resolution was passed, and the six months' notice was given on August 4th, 1899. The Telegraph Act was passed on August 9th, 1899. The Corporation did not, in fact, enforce against the company the removal of the underground works, but on February 23rd, 1900, they wrote that from the expiration of the notice of August 4th, 1899, the underground works could remain on sufferance only. Nothing further was done till August 8th, 1902, when the Postmaster-General granted a licence to the Corporation. That licence contained nothing specifying any period for the duration of the powers contained in the agreement of March, 1899. It was, in fact, wholly silent on the subject. The Postmaster-General certified, in the language of Section 3 of the Act of 1899, that it was proved to his satisfaction that the company had incurred expenditure in laying down underground wires. Under these circumstances, two questions arose for decision—first, whether Article 20 of the agreement of March, 1899, had been complied with; and secondly, if it had, then what was the result, having regard to Section 3 of the Act of 1899? Upon the first point, he was of opinion that Article 20 had been complied with. There was no question but that due notice had been given of the special resolution, and that it was passed. He thought that the further provision that the company should be heard if they required to be heard had also been complied with. Sufficient notice was given to enable the company, in fact, to have convened a board meeting, if so minded. The did not do so, but the two directors and the general manager of the company who attended were heard at such length as they desired. The matter was one which, from the point of view of the Corporation, whether rightly or not was urgent. There was, he thought, nothing oppressive in their declining under these circumstances to adjourn the matter. He thought the language of Article 20 was satisfied, and he was, therefore, of opinion that due notice to determine was given. The second question was as follows:—At the date when the Act was passed the company were in possession of powers which would expire on February 4th, 1900. The license in favour of the Corporation was not granted till August, 1902. At that date there existed in the company no powers by agreement with the local authority upon which Sec. 3 could have operation so as to continue them. For this purpose the material date as regarded the existence of the powers was not the date of the passing of the Act, but the date of the granting of the new licence. Upon this ground, first, he thought the plaintiffs failed. Again, secondly, he had this to say upon the construction of Sec 3 of the Act of 1899. Sec 3 (1) was addressed to the continuation of powers acquired by agreement with the local authority. Sec 3 (4) had to do with the extension of the licence granted by the Postmaster-General to the company. The language of the latter was quite free from ambiguity. The licence was there to be extended and continued for the period specified in the new licence for the duration of the new licence. He thought it was intended in this case to leave it to the Postmaster-General to say in issuing the new licence, what was reasonable as regarded the duration of the powers acquired by the old company by agreement with the local authority. The new licence, in this case, specified nothing as to the duration of the powers. If, therefore, his construction of the section was right, then upon this ground again the plaintiffs had not, by the statute, obtained any extension of the agreement of March, 1899, but its power came to an end upon the expiration of the notice given on August 4th, 1899. There was a third way of stating it which was this. The powers which the company had acquired by agreement were determinable powers. If he assumed, contrary to that which he thought was the true construction, that the word "thereof" meant "of the new licence," then the Act only continued for the period specified in the new licence, for the duration of the new licence, powers of which were determinable, and which had been determined. Upon these grounds, he thought the plaintiffs failed, and he dismissed with costs the action which claimed a declaration that the plaintiff company had acquired powers until December, 1911, under the Act of 1899 and which sought an injunction to restrain the Corporation from removing the underground works. At the same time, his Lordship hoped that means would be found to utilise the existing underground system, and avoid the idle waste of money that would be incurred by removing the present system and laying another.

It was stated by counsel for the plaintiff company that if no arrangement was come to between parties, and the plaintiffs appealed, the underground wires would not be disturbed pending the appeal.

Counsel for the plaintiff company: Mr. Haldane, K.C., Mr. Astbury, K.C., Mr. Forbes Lankester and Mr. H. H. Gaine; for the defendant Corporation, Mr Danckwerts, K.C., Mr. Buckmaster, K.C., and Mr. R. J. Parker.

Premier Lamp Co. *v.* Binko.

The Premier Electric Lamp Co., of Liverpool, sued Messrs. H. Binko & Co., of London, for £40 for electric lamps supplied. Defendants said that some of the lamps were defective, and their reputation had suffered as a result. Judge Lumley Smith said that the defendants' views about loss of reputation, &c., were all moonshine. He gave judgment for the plaintiffs on the claim, and excluded defendants' counterclaim for £96.

PARLIAMENTARY.

Joint Committee on Municipal Trading.

Lord Rothschild presided on 25th ult. over the second sitting of the Joint Committee on Municipal Trading.

Sir Andrew Noble, of Sir Wm. Armstrong & Whitworth, Newcastle-on-Tyne, was the first witness, and in reply to the chairman, said he was of opinion that trading by Government and municipal bodies ought to be restricted within the narrowest possible limits. His view was that the duty of municipal or local authorities was to see that those who carried on undertakings such as gas and electric lighting did their work in an efficient manner, and they could perform that duty much better if they did not carry on such undertakings themselves. He would absolutely debar municipalities carrying on the manufacture of, and trading in goods, wares or merchandise, and thus compete with their own ratepayers.

As to such enterprises as gas and electricity? I think these things are better and more economically performed by private bodies.

You think that a municipality being engaged in a gas undertaking will oppose the introduction of electric lighting for fear of their own particular industry being ruined?—Yes.

Continuing, Witness said that owing to the legislation in England, we were behind almost every other nation in Europe with regard to the supply of electricity and telephones. His own experience was that nearly every nation in Europe was far before England with regard to telephones, and that would not have been the case if the inventor of telephones had been allowed to work his own invention. Municipalities frequently opposed electric lighting and power Bills. Again, it was obvious that the conditions placed on electric lighting undertakings regarding purchase prevented a great number of people going into them, and had done a great deal to delay the introduction of electricity. In fact, the Act had to be altered.

You think, therefore, that municipal trading leads to the discouragement of private enterprise?—Yes, I do.

In your own town of Newcastle water, gas and electricity are provided in a satisfactory manner by private enterprise?—That is so.

Newcastle was one of the earliest provincial towns to have an electric supply, and you think that was due to the fact that the gas supply was in private hands, and therefore the municipality had no reason to oppose it?—That is so.

The Newcastle tramways have been taken over by the Corporation?—Yes. The original estimate was £400,000, but £800,000 has been expended, although it is only fair to say that some of that extra amount was due to extensions.

Notwithstanding this great expenditure, the electrical tramways in Newcastle pay now?—I really cannot say unless I had the opinion of an accountant. I know that the Corporation have relieved themselves of certain very proper rules which they had when the tramways were in the hands of a private company. For instance, the private company were only allowed to carry a certain number of passengers, but so late as yesterday I saw twice the authorised number of persons in a car.

Continuing, Witness said he was of opinion that those who paid the greater part of the rates had little real control over municipal expenditure. In the case of his own works in Newcastle and Manchester they paid no less than £18,000 a year in rates, and they were not represented in any way. He thought that grossly unfair, and he advocated that joint stock companies should be given a graduated scale of voting proportionate to the amount at which they were assessed. The borrowing powers also of the Corporation ought to bear a greater fixed relation to the assessable value than at present. There should also be a government auditor for all local

bodies' accounts. The accounts ought to be made out in such a form that the ratepayers could clearly understand what allowances had been made for deterioration, and so on. According to his experience, nothing was more fallacious than figures unless they were checked by people who understood what charges ought to be made, and who would see that all sums spent were properly placed where they ought to be. If accounts were made out in such a form he believed it would be a great deterrent to municipal trading. He also objected to the employés of municipal bodies having votes, as they were thereby able to bring pressure to bear with regard to the rate of wages and hours of labour.

By Lord De la Zouch: The question of overcrowding on the tramcars was not a great matter, and he merely mentioned it to show that the Corporation made rules for itself which tended to increase their income, which they would not allow to a private company. Now the undertaking was in the hands of the Corporation there was no supervising body in the public interest, and therefore there was a distinct loss to the public as compared with the case of a municipal body insisting on a private company serving the public in the best possible way. With regard to the profits of one undertaking going to make up a deficit on another, he did not know that that mattered, so long as it was clearly stated and fully understood what the result of each particular undertaking was. He agreed, however, with the suggestion that where a profit was made on tramways it should be used for the reduction of fares.

Replying to Mr. Fenwick, Witness said that anything which could be equally as well done by a private company as a municipality ought to be left to the private company. They would find that all the great advances in manufacture had been made by private individuals and not by public bodies. Even if municipal bodies could do the work as efficiently as private companies—which he did not admit—he was still opposed to them doing it, because it was not to the interests of the country that private enterprise should be crushed. He thought the tramways in Newcastle would be better worked by a private company.

Answering Sir J. Woodhouse, Witness said the electric light supply of Newcastle was in the hands of two companies; but he was not a director of either. The supply was carried on perfectly to his satisfaction, except that as the Legislature limited the time of the electric lighting concern to 21 years it had seriously affected England as compared with the other nations of Europe. He believed the charges for electricity in Newcastle were quite satisfactory, and he believed the rate charged to the North-Eastern Railway Co. was the lowest he had ever heard of for electrical power. He believed the average price for lighting was about 3d. per unit. He had a strong objection to Corporations carrying on tramways. He was aware that Corporations had made a profit out of tramways, and believed that Glasgow was the most successful.

They have reduced the fares to an absolute minimum—to ½d.; could private enterprise do better than that? I have not seen their accounts.

Do you suggest that the accounts of Glasgow are made up improperly?—I cannot say.

Could private enterprise do better or do as well?—I believe private enterprise could do as well—I am quite sure of it.

Could do it better?—I can't say.

You disapprove entirely of the policy and practice of Parliament in presenting these powers to municipalities?—I disapprove entirely.

Mr. A. Smith, town clerk of Birmingham, gave evidence with regard to the suggestion made at the previous sitting by Sir S. Provis that there should be Government auditors for municipal accounts. He pointed out that it was absolutely necessary that a man with local knowledge should be entrusted with the duty. He preferred to keep the accounts of Birmingham in the manner they were now kept, and handed in the last copy for the information of the Committee. If the Local Government Board laid down a schedule or statement of particulars to be sent in annually he would have no objection to that. He believed in publicity, and had always had it in Birmingham.

Mr. Fenwick: Do you work your own tramways in Birmingham?—We are in a transitory stage. We have only within the last few days had a stiff fight in the House of Lords with the British Electric Traction Co. who have obtained the tramways around Birmingham. We own our tramways, but they are at present leased. One lease falls in this year and a good many in 1906 and the whole in 1911.

And then you will work them?—Yes; we have a Bill in Parliament enabling us to work them at the end of the lease.

Mr. Arthur Kay, J.P., of the firm of McArthur & Co., Glasgow, said he was the second largest ratepayer in Glasgow. Broadly speaking, he was an opponent of municipal trading, and his object in coming there was to criticise the financial methods of the City of Glasgow. He wished to show that the City of Glasgow had a peculiar way of managing its loans. They had at various periods issued large loans, and were by Act of Parliament obliged to provide a sinking fund. By a subsequent Act the Registrar who was the same as the treasurer, was allowed to have the management of this sinking fund, and instead of bringing up the stock, he used this sinking fund in various municipal enterprises.

So that when the loans fall due, you affirm that the City of Glasgow will have to issue fresh loans because there will be no liquid capital to pay off these loans?—They admit that.

And your affirmation is that a large number of these assets may be valueless or of less value when the loans fall due than they are supposed to be?—Yes; they are certainly not liquid.

Another point you wish to call attention to is the working of the tramways?—Yes; the tramways have a peculiar system of working.

The tramways are a great success?—Certainly.

And they had been a great convenience to Glasgow and the inhabitants?—Unquestionably.

And they apparently show a very large profit?—Yes.

Your allegation, as I understand it, is that the tramways cannot come upon the rates for a loss?—That is quite correct.

If there were a loss on the tramway undertaking, would it come on the fund which is called "the common good"?—Yes.

And on the municipal councillors themselves?—Technically, I am told that is the case.

In order to obviate a loss, a certain portion of the expenditure which ought to be debited to the tramways account, has been debited to other accounts which come upon the ratepayers?—That is so.

Continuing, Witness said that, by an Act of 1883, the finance of Glasgow was consolidated, and all the various undertakings of the city were made to fall upon the rates, except the tramways. At present the city was in the extraordinary position of having the telephones and the electric light undertakings on the rates, while the tramway undertaking was not upon the rates. The Consolidating Act had given the most sweeping powers with regard to municipal trading, and, as many ratepayers believed, the most dangerous powers. As he had stated, the sinking funds had been used in other municipal undertakings, and the result was the accumulation of what he would call a great commercial capital. In consequence of the financial policy pursued, while the total debt of Glasgow was about £13,000,000, yet fully half was not represented by script of any description. The tramways were not represented by script at all, but there was a loan from the Bank of England of £500,000; a loan of £120,000 from the Union Bank of Scotland; and £303,000 sundry loans from private lenders, which made, with other small figures, about £1,000,000. The tramway undertaking was financed entirely on what, if he could use the term, he would call "open accounts." He did not object to the way in which the tramway accounts were kept, but to the lines on which the undertaking was started. The results of the tramways, while perfectly satisfactory, were not such as he believed would have been arrived at by a private company. The undertaking was favoured inasmuch as the road department bore a large portion of the expenditure, which, he contended, ought to be charged to the tramway account. Whenever a street widening took place for a tramway, the whole of the cost was debited to the improvement account, and none to the tramway account, so that the tramways may be looked upon as a sort of spoiled child of the city in the way that extraordinary facilities were granted to it.

By Mr. Powell Williams: Roads which, for the last 20 years, had required widening, were widened directly they were wanted for tramway purposes. If only a portion of the cost were debited to the tramway undertaking, they might not say much about it. So long as the tramways were worked by a private company, the Corporation refused to widen the roads; but directly the Corporation became the owners they bought up the land, and what was more, they put up expensive property upon it.

In further cross-examination, Witness said that in Glasgow they could afford to pay a good man to manage the tramways, and it was a good thing that the matter was left to officials. He contended, however, that the Town Council was established to look after the health and good government of the city, and not to launch out into all kinds of trading. The electric light undertaking of the Council had, so far, hardly managed to pay its way, and he did not believe a proper amount was written off for depreciation. Then they had the telephones which had had too short an existence for him to give an opinion upon, but the telephones had developed animosity between the Corporation and the National Telephone Co., and they had recently cut off the National Telephone Co. from the municipal buildings altogether. When competition between a Corporation and a private enterprise degenerated into bad feeling, it showed what the dangers might be. He thought they ought to know whether the tramway extensions outside the City boundary paid.

By Sir J. Stirling Maxwell: His complaint about the tramways was that the undertaking was given advantages which would not be given to a trading corporation. In the case of Motherwell just recently, the private company had to pay very heavily for the improvements.

Replying to Sir J. Woodhouse, Witness said the tramway users got full benefit by the reduction of fares to a minimum.

The Committee adjourned.

Earl Crewe presided on Monday at a further sitting of the Joint Committee.

Mr. Chas. H. Wilson, President of the Incorporated Society of Accountants, Mayor's auditor, and Chairman of the Parliamentary Committee of the City of Leeds, said he was in favour of provision being made for the more adequate and efficient audit of the accounts of municipalities by professional auditors only, who ought to be appointed by the respective municipalities, subject to the approval of the Local Government Board. He was strongly opposed to any extension of the audit department of the Local Government Board. It was requisite, when trading concerns were carried on, that auditors should be familiar with the drawing of trading and profit and loss accounts and balance-sheets. In trading operations carried on by municipal authorities, a standard form of accounts should be presented by the Local Government Board, in consultation with the Institute of Chartered Accountants, the Incorporated Society of Accountants and Auditors, and the Incorporated Institute of Municipal Treasurers and Accountants. Separate accounts should be kept for each undertaking carried on, and the profit and loss account should be clearly shown after making all necessary allowances for depreciation. In this connection he pointed out that all the plant and equipment should be properly maintained in perfect working order, as obviously, if this were not done, the revenue-earning capacity of the

undertaking would be seriously interfered with. The heads of departments should be required to certify that this has been done. This was not dependent on the operation of the sinking fund, nor any extra depreciation fund which it might be thought necessary to set up. The net profits of any municipal undertaking should be paid over to the account of the borough fund. Therefore any loss which might result from the trading department should also be made good out of the rates, but the balance of profit from one department should not be transferred to meet the loss of another department.

In cross-examination, Witness said he was not in favour of municipalities running tramways at cost price, because a number of people who were not ratepayers were carried. Corporations ought to be allowed to invest their sinking fund in their own undertakings. He was not in favour of municipalising everything, and thought the operations of Corporations should be confined to the things they now went in for.

Mr. Jeeves, town clerk of Leeds, said the accounts of municipalities were well kept, and all separate items properly chargeable to the undertaking were so charged. His own opinion was that a Government audit would not change the positions of various undertakings. While agreeing with the suggestion that certain street improvements should be charged to tramways, he would point out that this could not be done save by special power. They had to make a return to the Local Government Board with regard to the electric light undertaking, and he should think it would be easy to compare such accounts with the accounts of electric lighting companies.

Mr. Shirley Price, M.I.E.E., of the firm of Messrs. Wheatley, Kirk, Price & Co., engineering valuers, said it was absolutely necessary to write off depreciation in the case of electric lighting, electric power and tramway undertakings. If they took the plant of an electric lighting undertaking erected 10 years ago at the cost of £50,000, he would be a bold man who would say that the actual value of such a concern to-day was anything like half that amount. If no depreciation were made the profit and loss account would be wrong to that extent This depreciation must be made quite separate from the sinking fund which was to replace loans. When they were dealing with machinery and plant this depreciation was bound to take place, although it would be accelerated or retarded by the method of maintenance. No practical man would dispute the fact that depreciation did take place, but the extent of the depreciation depended on a variety of conditions, some of which were beyond the control of the user. If the user took pride in his plant, he would maintain it at a high standard, and by so doing minimise the depreciation, but under the best conditions depreciation must take place. In new enterprises this had been particularly the case owing to new inventions and improvements. He supposed there was scarcely an electric station about five years old which had not had to discard costly plant, some scarcely used, in order to replace with some new invention giving more economical and desirable results. He knew it was the rule for private companies to at once write off such discarded plant, but he did not know what municipalities did. There was only one way in which the proper amount could be written off accurately for depreciation, and that was by the actual examination by an expert valuer. He knew of no Corporation which had adopted the principle of periodical valuation, but it was a common custom amongst high-class engineering firms to have such valuations.

In answer to various members of the Committee, Witness said that the first valuation as he had suggested in the case of Leeds, would probably cost £2,000 or £3,000, and he thought it would be a practical thing for a Government valuer to be appointed to value municipal properties.

Mr. John Astle, of the Battersea Municipal Alliance, gave evidence with regard to the growing debt and rates of Battersea, and drew attention to the way in which the work carried out by the works department of the borough had largely exceeded the estimates. In the case of the municipal electric lighting undertaking there in 1901—2, the working expenses were £4,242 2s. 6d.; the interest on loan, £3,429 12s.; and the principal repaid, £379 14s. 7d. The revenue for the year was £4,203 2s. 5d., showing a loss of £3,849 6s. 8d. Since the electric light undertaking first commenced there had been a loss to the ratepayers of £9,000, and no allowance had been made for depreciation. He deprecated the easy facilities given by the London County Council for the obtaining of loans, and thought the County Council ought not to make a profit on such loans.

Sheffield Corporation Bill.

On 23rd and 24th ult. a Select Committee of the House of Commons, under the chairmanship of Mr. Heywood Johnstone, considered the Omnibus Bill of the Sheffield Corporation. Parts of the Bill were opposed by the Electrical Traders' Association of Sheffield.

Mr. Baggallay, K.C., who represented the Corporation, said the third part of the Bill related to tramways, but the promoters did not propose to proceed with the portion relating to new tramways, but only with the portion which related to the making of a tunnel for the purpose of carrying cables for the transmission of electrical energy to certain portions of the tramways. In Part 4 the Corporation sought various powers with regard to the supply of electrical motors and apparatus.

The Committee having dealt with the portion of the Bill concerning waterworks,

Mr. Hassett, who represented the Electrical Traders' Association, stated that an arrangement had been come to between the parties with regard to the electrical portion of the Bill, and the following substituted clause 26 had been agreed upon:—

"1. The Corporation may purchase and may supply, sell and let for hire, but shall not manufacture, electric motors, apparatus and things for cooking, heating, ventilating and for motive powers, and may provide materials and do all work necessary and proper for the fixing, setting up, connecting with supply mains, alteration, repair, or removal thereof, and may take such remuneration in money or such rents or purchase for and make such terms and conditions with respect to such supply, selling, letting, or use, setting up or altering, or repairing or removal, and for securing the safety and return to the Corporation of such motors, apparatus and things as may be agreed upon between the Corporation and the persons to or for whom the same are sold, supplied, fixed or set up; and the provisions of Sec. 25 of the Electric Lighting Act of 1882 shall extend and apply to all such apparatus and things.

"2. Any expense incurred by the Corporation in carrying into effect the provisions of this section shall be deemed to be expenses incurred by the Corporation under the Electric Lighting Act of 1882, and not otherwise provided for, and the provisions of Secs. 7 and 8 of that Act shall extend and apply accordingly to such expenses.

"3. Any moneys received by the Corporation under this section shall be applied in manner provided by Article 61, paragraph B of the Sheffield Electric Lighting Order of 1892."

This part of the Bill was then agreed to, and the Committee proceeded to deal with matters not electrical.

Royal Commission on London Traffic.

Sir David Barbour (chairman) presided over a further meeting of the Royal Commission on London Locomotion held at the Westminster Palace Hotel on Friday.

Mr. E. Harper, statistical officer of the London County Council, occupied the witness-box all day, and submitted an immense number of statistics relative to London population and the difficulty of housing the workpeople. He expressed the opinion that travelling facilities were of the utmost importance for dealing with the problem of housing, and contended that there must be some inducement given to workmen to live further out from the centre. He showed that rents in the central area do not represent the true commercial standard, and that the differences between the rest of the county and extra-London are sufficient to cover a workman's travelling expenses and extra cost of meals. He thought that workmen's trains should be increased, and that the maximum charge should be 2d. for 20 miles—10 miles each way.

Witness was examined at some length as to the question of on whom shall fall the loss arising from the provision of a cheap means of transit, and he held that there was a precedent in the Cheap Trains Act for the loss falling on the carriers.

Sir J. Dimsdale put it to witness that what his contention really came to was that the shareholders in railway companies, who found the money to construct railways, were to bear the cost.

Witness admitted that what was for the benefit of the whole community ought to be borne by the whole community, but pointed out that the community had dealings with the railway companies and granted them privileges, and thus had the right to expect something in return. When railway promoters came before Parliament, they had certain powers and certain obligations conferred upon them, and shareholders subscribed money in the light of having both privileges and obligations.

Replying to Sir J. Dickson Poynder, Witness thought that the great trunk lines could assist in solving the problem by having branch lines, and pointed out what the Great Eastern Co. had done in this way. In the case of the Waterloo and City Railway, no doubt that had relieved the streets of cab traffic to some extent by affording passengers by the London and South-Western Railway a quick and easy means of reaching the city.

Witness proceeded to deal with the omnibus traffic, and gave a great many figures relative to the rates charged for workmen, and further showed the approximate speeds per hour on the "Tube" and other underground railways. He suggested that extensions underground of railways and tramways through the central area would relieve both pedestrian and vehicular traffic in the streets. He referred to the effects produced in the case of the Central London Railway and the electric tramways which feed it, and suggested the provision of cheap travelling facilities into and out of London in every direction.

Charing Cross, Euston and Hampstead Railway Bill.

The Charing Cross, Euston and Hampstead Railway Bill came before the Earl of Belmore's Select Committee of the House of Lords on Wednesday last week. Counsel for the promoters were Mr. Balfour Browne, K.C., Mr. Thomas, and Mr. Ross

The promoters' case was opened by Mr. Balfour Browne. He said that the promoters, the Charing Cross, Euston and Hampstead Railway Co. desired, in the Bill, to have powers to acquire a certain small piece of property for the purposes of a station at North End, Hampstead. They also required powers to make some alteration in one of the clauses of the Bill. The Tube line already authorised ran from Charing Cross, under the Charing Cross Road, Hampstead Road to Euston Station, and from Euston Station to Camden Town. At the latter place the line branched off, one portion going to Kentish Town and Highgate Hill, and the other, really a continuation of the main line, proceeding to Hampstead and Golder's Green, at which place there was a terminus. In the course of time, no doubt, that portion of the line would be continued to Watford. Motor carriages would be used on the line, as it was found that they did not cause so much vibration as separate locomotives did. Dealing with the question of the clause, he said that there was at one time a

proposal to transfer a line from Golder's Green to Edgware to the promoters. The London County Council objected to that, and the clauses providing for that transfer were accordingly struck out of the original Bill. The same body, the London County Council, now objected to clause 31. That clause was for the purpose of giving effect to an agreement between the promoters of the present scheme and the Underground Co., by which agreement the latter company were to supply the promoters with the necessary current for working the line. The original Bill sought power to lease the whole undertaking to the Underground Co., but this was struck out by the Select Committee of the House of Commons when they considered the Bill. Counsel said that the Underground Co. was a company which had been formed for the purpose of generating and supplying on a very large scale the current required by a number of the tube railways of London. It would be seen, therefore, that the company could supply electricity very cheaply. In fact, the company could supply current at a cheaper rate than the railway could.

Mr. Pollock, K.C. (for the London County Council), said that what the Council objected to, were the words in the clause "working and handling traffic." The Council wanted to prevent a limited company from working a statutory railway. "Working," said counsel, "is a word which means a good deal in railway matters."

As this point the Chairman of the Committee suggested that perhaps the objection might be met by the insertion of the word "electrical" before the word "working"

Mr Thomas (for the promoters) intimated that the promoters would accept that.

Mr. Perks was then called and gave evidence very briefly, saying that what the promoters required, was that the control of the electrical working of the line and the men employed in that working should be under the control of the Underground Co., who supplied the current.

Mr. Pollock, K.C. (for the London County Council), addressed the Committee.

Mr. Yerkes, who was called on behalf of the promoters' case, said that it was most important that the working of the line should be under one head. The promoters had unfortunately, given up their powers to generate the necessary electricity for their line. It was most essential that the engineers and mechanics who had to control the working of the lines should themselves be under the control of the company supplying the current Should the word electrical be inserted, it would mean that the only man on a train who would be under the control of the company, would be the man in charge of the motor. It was not the intention of the Underground Co. to interfere in any other way with the working of the line. It was not intended to control the company, and they (the company) had now given up all ideas of leasing the undertaking to them They merely required to have control of the men who worked the trains, signals and the lifts

Witness, cross-examined by Mr. Pollock, K.C., said that he had supplied electricity to many companies, and in every case there was some arrangement by which the company supplying the current had some control over the men engaged in the working of the line.

Re-examined by Mr. Thomas: There was no intention of interfering with the rates and charges or fares, or any of the managerial work in connection with the working of the railway. All the company desired was to have supervision over the actual working of the trains.

Mr. Galbraith, the engineer to the company, was called to give evidence with regard to the proposed purchase of property at North End for the purpose of a station. He said also that there was a proposal to alter the level of the line were it passed under Golder's Hill.

Evidence having been concluded, the question of the clause was again considered.

Mr. Pollock suggested that the words "and the use of such power or current on" might perhaps be substituted for the words "for the working and handling of traffic." Another suggestion he made was that the agreement should be subject to the approval of the Board of Trade.

Mr. Thomas (for the promoters) considered that the suggestion with regard to the Board of Trade was without precedent. Everything on the railway was subject to the Board of Trade. If such a suggestion were carried out it would be a dangerous extension of the ordinary law. With regard to the clause, all they asked for was that they should enter into an agreement with the Underground Co. for the electrical working of the line.

The Chairman at this point ordered the room to be cleared.

After conferring for some minutes, the Chairman said that having considered the matter of the clause, the Committee could not see that there was much difference in the two suggestions. However, they had agreed that the clause should be as suggested by the promoters, and that it should be subject to the approval of the Board of Trade. They accordingly found the preamble proved.

City and South London Electric Railway.

The Earl of Belmore's Select Committee of the House of Lords had this Bill before them for several days last week. The Bill had already passed a Select Committee of the Commons earlier in the present session.

Counsel for the promoters were Mr. Moon and Mr. H. Lloyd.

Opposition to the Bill came from the Metropolitan Railway Co., represented by Sir Ralph Littler, K.C., who petitioned on the ground of competition.

In opening the case for the promoters, Mr. Moon explained that the Bill sought to empower the company to construct and work a length of tube railway from the Angel, Islington, to King's Cross and Euston, as a continuation of the existing line. Another proposal of the Bill was to authorise the company to take over the construction of the already authorised line to Brixton, and in connection with that line to make a tunnel under the river, and to construct a new station at King William Street. Dealing with the first part of the scheme—the Angel-Euston line—counsel said that it was considered to be a most desirable improvement. At present the line ended at Islington. At Islington there was the Agricultural Hall, and the only way of reaching that place from the North and North-West at the present time was by way of King's Cross or the North London Railway. The extension to Euston would be a valuable addition to the means of transit in London, for it would place the North in direct communication with the South. That a large traffic was carried South was shown by the fact that one third of the passengers who booked at the Angel were carried to the extreme south of the line.

Mr. C. G Mott, the chairman of the line, was the first witness called. He gave evidence of the number of passengers carried, and was cross-examined by Sir Ralph Littler for the Metropolitan Railway Co.

Sir Benjamin Baker, the engineer to the company, gave engineering evidence of a similar nature to that given by him before the Commons Committee.

Cross-examined by Sir Ralph, Witness said that it was true that the proposed extension did not carry out the recommendation of the Joint Committee of Tube Railways, that such lines should run to the circumference of London. That defect would be obviated, however, by the services of the Great Northern, Midland, and the London and North-Western Railways. To carry luggage on a railway such as this, with a two-minute service, would greatly dislocate traffic.

A large number of local witnesses were then called.

Mr. Turnbull, general superintendent of the London and North-Western Railway Co., Mr. Forbes, general manager of the London, Brighton and South Coast Railway Co., and Mr. Mathieson, general manager to the Midland Railway Co., also spoke in favour of the Bill, Mr. Forbes saying that the line would be very convenient for the long-distance traffic between the Midlands and the South Coast watering places.

On Friday Alderman Dew, L.C.C., said that the National Association for the Extension of Workmen's trams, of which association he was secretary, was strongly in favour of the extension.

Mr. T. C. Jenkin, the general manager of the company, was also called in support. This concluded the case for the promoters.

Sir Ralph Littler (for the Metropolitan Railway) said that he would call witnesses before addressing the Committee.

Mr. A. C. Ellis, the general manager of the Metropolitan Co., was then called. He considered that his company provided all the accommodation required by their Gower Street station. When his company's line was electrified there would be an increased service, with similar rolling stock to that on the City and South London Railway. He thought that his company should have some protection at a time when they were expending large sums in electrifying their railway.

Sir Ralph Littler having addressed the Committee, Mr. Moon replied on behalf of the promoters. With regard to the electrification of the Metropolitan Railway, he said that it was true that the company were electrifying the line, but they were electrifying the whole line, and the large sums talked about were not being spent only on the short portion with which it was contended the South London line would compete.

At the conclusion of counsel's speech, the Committee, without clearing the room, found the preamble proved and the Bill was ordered to proceed.

Gosport and Fareham Tramways.

The Bill of the Portsmouth Tramway Co. was before a Select Committee of the House of Lords last week, presided over by Lord Hatherton. Mr. J. D. Fitzgerald, K.C., Mr. A. C. Worth and Mr. L. Macassey appeared for the promoters; the opponents being represented by Mr. Pember, K.C., and Mr. Page, K.C.

In opening the case, Mr. Fitzgerald said the Bill was one promoted by the Portsmouth Tramway Co. with the object first of equipping the Gosport tramways with electric traction, and to extend them to Alverstoke, which was being done at the express desire of the Urban District Council of Gosport and Alverstoke. The second object of the Bill was to construct an additional tramway from Alverstoke to Fareham; through Fareham to Portchester and Cosham, where a junction would be formed with the recently opened Horndean and Portsdown Light Railway—a railway which belonged to the Provincial Tramways Co., who were also the owners of the share capital of the Portsmouth Tramway Co. The only opponents of the Bill were the London and South-Western Railway, who alleged that the trams would compete unfairly with their line, but learned counsel said he thought he would be able to show the Committee that there was nothing serious in the opposition.

Mr. A. W. White gave evidence in favour of the Bill. He said he was the original promoter of the Portsmouth Street trams, the Gosport Street trams, and the Horndean and Portsdown Light Railway. Before the construction of the Portsmouth tramways, the only public means of conveyance were two omnibuses; whereas now the tramways carried 360,000 passengers a week, or the population of Portsmouth twice over. The light railway line had succeeded beyond all expectation. It was contemplated that the entire tramway would serve a population of about 300 000. He agreed that the existing train service was well worked by the London and South-Western Railway as far as through traffic was concerned, but it was practically of no use for purposes of local traffic.

Mr. H. W. Sandford, chairman of the Gosport District Council, having given evidence in favour of the Bill, Sir Charles Owen, the general manager of the London and South-Western Railway, gave evidence against the proposal. He contended that it would be unfair to his company to allow of the construction of the proposed tramway, which throughout practically its whole route would run parallel with his company's line. They did not object to the electrification of the existing line, nor to the construction of the short piece of line into Gosport—what they objected to was a through line which would take away their traffic.

After hearing counsel in opposition to the Bill, the Committee found the preamble proved, except in the case of the proposed line from the boundary of Fareham to Cosham.

Brighton Corporation Tramways.

A Select Committee of the House of Lords, presided over by Lord Hatherton, was on 25th and 26th ult. engaged in the consideration of the Brighton Corporation Bill, which seeks to authorise the Corporation to construct and work additional electric tramways in the borough, and run motor-omnibuses in connection therewith. Mr. Pember, K.C., Mr. C. Baggallay, K.C., and Mr. G. J. Talbot represented the promoters

Mr. Pember, in opening the case, said it was proposed by the Bill to extend the tramway system by the construction of a tramway to connect Brighton station with the Pavilion *vid* Queen's Road and North Road; another up Terminus Road and Buckingham Place to Seven Dials; a third from Seven Dials down Montpelier Road; a fourth from Seven Dials up Dyke Road; and a short length of line along Goldsmid Road from Seven Dials to the city boundary. They also wished for powers to run motor-omnibuses, and to charge a higher fare on the Elm Grove route on race days. The proposed lines would add about 3 miles to the existing system. There was a great deal of opposition from frontagers, and in the case of the motor-omnibuses, they were opposed by the omnibus company. The petition by the National Telephone Co. had been withdrawn.

Ald. J. C. Buckwell, the Mayor, gave evidence, and stated that the Corporation had already spent £190,000 on tramway, and on an average they carried about 20,000 passengers a day on 6½ miles of tramways. The earnings for the year ending March 31st were £43,700, and the total expenditure, including interest and sinking fund, was £39,563, which left a net profit of £4,135 on the year's working. The Corporation proposed to run motor-omnibuses outside the borough if they found it advisable.

Mr Ald. Stafford, chairman of the Tramways Committee, stated that the tramways had been a great success. Ample funds were set aside to keep them in perfect condition.

Mr. Kincaid, consulting engineer to the Corporation, believed the scheme was a satisfactory and workable one, and likely to give good results.

Witness was questioned by Sir R. Littler, K.C. (who represented the gas company), with reference to electrolysis, and said he did not think any protective clause was necessary for the gas company. The Bill contained the model clauses with reference to electrolytic action.

Mr. T. Holliday, the tramways manager, was questioned with regard to the gradients, and said there were worse gradients on existing routes where the tramways had worked satisfactorily.

In cross-examination, he said he was not aware that any damage had been done to the gas company's property by the tramway. The gas company had made claims upon the Corporation, but the Council had repudiated liability, acting on his advice, as the damage had nothing to do with the trams. As a rule, a well-conducted electric tramway appreciated the value of the property it passed near. The inclusive cost of electric energy was 1½d. per unit, and the working expenses per car-mile were 9·2d. and the revenue 10·1d. per mile.

The Brighton cars were equipped with three brakes to prevent accidents, and they had not had a single accident. They had gradients at Brighton far worse than at Chatham, and they had not had an accident.

A great deal of local evidence was then called.

Mr S. Sellon, electrical engineer, was called with reference to the question raised as to electrolytic action. He stated that a Joint Committee of both Houses of Parliament had inquired into the matter, and the Board of Trade had made regulations with respect to it. Application for an extension of these regulations had been refused. The Bill before the Committee contained the model provision approved by the Board of Trade and Parliament, and that was sufficient. Speaking generally, he thought that no danger need be apprehended in any properly constructed tramways.

Sir R. Littler handed in several pieces of partially fused pipe, some of which he said had been taken from Ship Street.

Witness said these were examples of fusion of the whole pipe, which had been melted, indicating a short circuit from the electric light wires, and this could never occur in connection with an electric tramway that was properly constructed. It only occurred in cases of faulty construction, and had, in fact, only been known to happen in America. Under certain conditions of soil small currents would produce electrolytical action.

On Monday further evidence was given by Mr. S. Sellon, with regard to electrolytic action. Witness was shown some pieces of damaged gas pipe and said the damage might be due to ordinary corrosion. He did not see that there was any need for a special clause to be inserted in the Bill.

Some more local witnesses were called with reference to the value of property, and the case for the promoters was closed.

The Chairman announced that the Committee considered that no case had been made out for the proposed tramway along the Montpelier Road, and that would have to be struck out. They refused, however, to allow costs to the objectors.

Mr Freeman, K.C., then addressed the Committee on behalf of the London and Brighton Railway, in opposition to the suggested tramways at Brighton Station. The company, he said, were not opposing in any hostile spirit, they did not object to tramways, but the scheme suggested would most seriously interfere with their traffic arrangements, as it would turn their forecourt into a public thoroughfare between tramways 3 and 4.

It was announced that the Corporation and the omnibus company had come to terms, the Corporation agreeing not to run motor-omnibuses along certain routes for a period of three years. The Committee again adjourned.

Pontypridd Tramways Bill.

A Select Committee of the House of Commons, presided over by Mr. Bond, on 25th, 26th and 27th ult. considered the Pontypridd Tramways Bill.

Mr. Ram, K.C., represented the promoters, and said that the Pontypridd Urban District Council sought to construct a tramway which would connect the existing tramways from Cilfynydd and Treforest with the Rhondda Valley, and they proposed to have powers to run over the Rhondda Valley Tramway. It was proposed to leave the road at Mill Street and go under the Taff Vale Railways, and for this purpose a new road would be made.

A large amount of local evidence was called in support of the Bill and the Committee found the preamble proved.

Mr. Page, K.C., on behalf of the frontagers of Mill Street, submitted a clause providing that the proposed tramway should not be constructed unless and until the promoters should have satisfied the Board of Trade that the road was of sufficient width to allow the working of the new tramways.

The Committee refused to introduce such a proviso.

Shropshire, Worcestershire and East Denbighshire Electric Power Bill.—On Tuesday this Bill came before Earl Morley's Committee of the House of Lords. The object of the Bill is to incorporate a company with a capital of £450,000 to supply electric energy for power purposes. The area of supply will be the whole of the counties of Salop and Worcestershire, and a part of the County of Denbighshire. Lands for generating stations are scheduled at Hadley, Upper Mitton and Llangollen. There was no opposition to the Bill, and the preamble was found proved.

Hastings Tramways Bill.—The Committee of the House of Commons reporting on this Bill to the House, states that it authorises the construction of extension tramways within the county borough of Hastings, and extends the periods limited by former Acts for the compulsory purchase of lands for the construction of the tramways and works authorised by the Hastings Tramways Act, 1900. It is proposed to enable the promoters to pay interest out of capital within the time limited by the Bill for their construction, and the Committee having heard evidence that the payment of such interest will naturally facilitate the raising of the capital, and that a considerable portion will be subscribed locally, consider that under the circumstances the payment of such interest is reasonable, and they have allowed the same.

North-Western Electricity and Power Gas.—Eleven petitions have been deposited in the Private Bill Office of the House of Commons against the above Bill, including petitions from the Northwich Electric Supply Co., the Altrincham Electric Supply Co., the Stalybridge and Dukinfield Tramways and Electricity Board, and a number of local authorities.

Manchester Corporation Bill—This Bill, which authorises, amongst other matters, the Corporation to construct certain small sections of tramways and allows further borrowing powers of £10,500 in respect of tramways, came before Lord Morley's Committee on Friday, and was ordered to be reported for third reading.

West Bromwich Corporation Bill.—Earl Morley's Committee on Unopposed Bills considered the above measure, which seeks to repeal certain sections of the Corporation's Act of 1900 providing that a space of not less than 9 ft. 6 in. should intervene between the nearest tramway rail and the footpath. This has been found impracticable, and the Corporation wish, with the consent of two-thirds of the owners, to construct tramways with less space. The Bill was ordered to be reported for third reading.

Hull Corporation Bill.—A Select Committee of the House of Commons under the chairmanship of Mr. Heywood Johnstone, was engaged in the consideration of this Bill on 25th and 26th ult. A number of matters were dwelt with in the Bill. Mr. White, the city engineer, gave evidence with regard to the tramway portion, and explained that the object of the tramways sought to be authorised was to link up tramways already authorised or in operation, and to open up fresh routes into the centre of the city by way of Alfred Gelder Street, High Street, over Drypool Bridge, along Clarence Street to Holderness Road, and also by way of Cottingham Road. There was no opposition to this part of the Bill, and it was passed, as was also a clause relating to the acquisition of lands for the construction of a generating station on the north side of Osborne Street.

Baker Street and Waterloo Railway Bill.—On 26th ult. the above Bill, which provided for the extension of time for the acquisition of lands and construction of the Baker Street and Waterloo Railway, came before the House of Commons Committee on Unopposed Bills and was ordered to be reported for third reading.

Dudley, Stourbridge and District Tramways.—It is reported that all opposition to this Bill has been withdrawn, and, accordingly, it will be referred to the Unopposed Committee.

Standing Orders.—The Standing Orders Committee of the House of Lords has reported that the Standing Orders not complied with ought to be dispensed with in the case of the following Bills, and the parties be allowed to proceed:—Metropolitan District Railway (Various Powers), Wigan Corporation Tramways, Romford and District Tramways, and the Beckenham U.D. Council. In the case of the Stroud and District Tramways Bill, it will be allowed to proceed, subject to the names of James Grainger Bellamy and Alex. Siemens being struck out.

Rochester Corporation Tramways.—The Standing Orders Committee of the House of Commons have decided that in the case of the above Bill, the Standing Orders ought to be dispensed with, and the parties be permitted to proceed.

L.C.C. ELECTRIC TRAMWAYS.

At a meeting of the Council on Tuesday, the Highways Committee recommended that they should be authorised to prepare plans, specifications, and estimates of the cost of reconstructing for the conduit system of electric traction the following existing tramways and constructing for the same system the new tramways mentioned as already authorised:—

1.—Existing Tramways for Conduit System.

1. Moorgate Street terminus, *via* City Road, to the Angel public-house Islington.
2. Angel, Islington, *via* High Street and Upper Street to Highbury Station, North London Railway.
3. High Street, Islington, *via* Essex Road, to St. Paul's Road.
4. Holborn, *via* Gray's Inn Road, to King's Cross.
5. Theobald's Road, *via* Clerkenwell Road and Old Street, &c., to Cambridge Road.
6. Mile End Road, *via* Cambridge Road and Heath, Mare Street and Lower and Upper Clapton Road, to Stamford Hill.
7. Old Street, *via* Great Eastern Street, Commercial Street and Leman Street, to near London Docks.
8. Clerkenwell Road, *via* Farringdon Road, King's Cross Road, to King's Cross.
9. King's Cross, *via* Pentonville Road to the Angel, Islington.
10. Aldersgate Street, *via* Goswell Road to the Angel, Islington.
11. High Street, Whitechapel, *via* Commercial Road, Commercial Road East, and East India Dock Road to Brunswick Road.
12. East India Dock Road to tramway terminus in West India Dock Road.
13. Aldgate terminus, *via* High Street, Whitechapel, and Whitechapel Road to Cambridge Road.
14. Hampstead Road terminus to south side of L. and N.W.R. bridge near Ampthill Square.
15. Norton Folgate, *via* High Street, Shoreditch, Kingsland Road and High Street, Stoke Newington, to Upper Clapton Road.

1a.—Authorised New Tramways.

1. Farringdon Road Meat Market, *via* St. John Street and St. John Street Road, to the Angel, Islington.
2. Holborn Town Hall, *via* Rosebery Avenue, to St. John Street Road.
3. Brunswick Road, *via* East India Dock Road, to county boundary at Barking Road Bridge.

The Highways Committee also recommended that the undernoted lines should be reconstructed or constructed for the overhead trolley system:—

2.—Existing Tramways for Trolley System.

1. East India Dock Road, *via* Burdett Road, to Cassland Road terminus.
2. Cambridge Road, *via* Mile End Road and Bow Road, to the county boundary at Bow Bridge.
3. City Road, *via* East Road, Bridport Place, New North Road, Southgate Road, Mildmay Park and Green Lanes, to the Manor House.
4. Mintern Street, *via* New North Road, Canonbury Road and Holloway Road, to Archway Tavern.
5. Mare Street, Hackney, *via* Graham Road, Dalston Lane, and Ball's Pond Road, to Essex Road.
6. High Street, Islington, *via* Liverpool Road, to Holloway Road.
7. Caledonian Road (from near Pentonville Road) to Holloway Road.
8. Pancras Road, *via* Great College Street, to Kentish Town Road.
9. Hampstead Road, *via* Camden Road, Parkhurst Road and Seven Sisters Road, to Finsbury Park.
10. Hampstead Road, *via* Kentish Town Road and Junction Road, to Archway Tavern.
11. Kentish Town Road, *via* Highgate Road, to terminus at Swain's Lane.
12. Kentish Town Road, *via* Prince of Wales Road, to Malden Road.
13. Hampstead Road, from south side of L. & N.W.R. bridge near Ampthill Square, *via* High Street, Camden Town, Chalk Farm Road, Ferdinand Street, Malden Road, Southampton Road, Fleet Road, Agincourt Road and Constantine Road, to Hampstead Heath.

2a.—Authorised New Lines.

1. Cassland Road terminus to Dagmar Road.
2. Lower Clapton Road, *via* Kenninghall Road and Evering Road, to Stoke Newington Road.
3. Junction between Ball's Pond Road (existing lines) and Mildmay Park (existing lines).
4. Essex Road, *via* St. Paul's Road, to Canonbury Road.
5. Great College Street, *via* Crowndale Road, to High Street, Camden Town.
6. Malden Road, *via* Prince of Wales Road, to Haverstock Hill.

Mr. S. Low, on the report coming forward for consideration, suggested that it should be postponed as negotiations were proceeding about which the chairman of the Committee would probably inform the Council. There was also another reason why the report should be adjourned, as it had been agreed that it should be discussed in conjunction with another report, which was not before the Council on that occasion, on the cost of electric traction.

Mr. Collins asked whether the chairman would bring up estimates of the cost of the proposed new electric tramways.

Mr. J. W. Benn, in reply, remarked that Mr. Low had anticipated the suggestion which he was about to make. In view of the conference which was to take place with the borough councils on the following day on the question of the systems for the northern lines, it was evidently necessary that the report should be postponed until next week, and then the other report, which by inadvertence had been omitted, would be reinstated and Mr. Low would be able to discuss the overhead and conduit systems. With regard to Mr. Collins's question, he said that the second report contained the figures which he desired.

The consideration of the report was then postponed.

CORRESPONDENCE.

The Cobden Club and Foreigners.

As I see that some people are still labouring under the delusion that the Cobden Club is composed of foreigners, will you permit me to state categorically in your columns that the only foreigners who are in any way connected with the club are honorary members who pay no subscription, and have no part in directing the policy of the club. They have been elected honorary members solely as a recognition of their services in advocating the cause of free trade in their own countries.

Harold Cox,
Secretary of the Cobden Club.

Gray's Inn, W.C.,
June 23rd, 1903.

Wiring Specifications.

I received a specification a few days ago which contained the following clause, which, I must admit—and I receive a lot of specifications from different engineers—strikes me as rather peculiar reading.

"The contractor to include in his quotation the sum mentioned in the specification as being set aside for certain special fittings that will be required. This sum represents the net prime cost of the fittings after deducting all trade discount but not the usual 2½ per cent. for cash, and he must include in addition in his contract a sum representing the profit he requires on fittings costing the amount mentioned."

It appears to me that this clause informs the private individual of a good deal more than he is entitled to know, and I suppose the next thing we shall be invited to do will be to state the actual nett cost of the whole work, and then add our profits.

If electric lighting specifications were scheduled in the same manner as a builder's specification, it seems to me that this class of work would partake rather less of the nature of a gamble than it does at present, as it would present prospects of a certain gain, rather than an unknown loss.

The extraordinary discrepancies between the highest and the lowest tenders in most contracts of any size, are a good example of how these amounts are guessed at. These discrepancies, as you may be aware, are not known in contracts for buildings, even when the amount is as much as 10 times that of an electric lighting contract.

Wiring Contractor.

[The requirement quoted by our correspondent certainly constitutes a remarkable and impertinent invasion of the contractor's private affairs; the consulting engineer has not the slightest right to the information demanded, any more than he has to a statement of the contractor's annual profits—or losses. Moreover, the information is unnecessary.—Eds. Elec. Rev.]

Electricity in Mines.

I should like to be allowed to correct a slight misapprehension in Mr. Simon's letter under "Electricity in Mines."

He is mistaken in supposing that I have overlooked the economy of high pressures at the motor terminals. My contention is that we secure, at present, no ultimate advantages by employing high-tension in such places as mines.

Mr. Simon forgets that a saving of this kind in the first cost of the installation is very liable to be swallowed up, or even exceeded, by expenditure on special casings, conduits, and other precautions against accident to the high-pressure lines, in the shafts and in-bye, and on maintenance of the same. The latter may become impossible, except at very great expense, where an unusual amount of "heaves" or other motion of the strata occurs.

The cables are, perhaps, to be considered as the most vulnerable portion of the system. Their improvement in a mechanical sense should, I think, pave the way for higher pressures.

E

I can agree with all Mr. Simon says as to the relative importance of switchgear.

As Mr. Scott has pointed out with much clearness, the primary considerations are safety of life and immunity from breakdown (stoppage). Cost of copper is, generally, of secondary importance in mining work. We should not lose sight of the fact that we have not yet introduced pressures of 3,000 volts, or similar values, into our houses and factories to any extent, and that in a colliery we have a dangerous and confined situation to begin with. We cannot rely upon rubber mats and gloves amongst a class of workmen in whose eyes a copper wire is as innocent an object as it is in those of the ordinary householder.

Adolphus B. Croft.

London, *June 29th*, 1903.

Shunt Losses in Meters.

In a letter in your issue of June 19th, Mr. Holden makes reference to my statement in a letter you published on June 5th, relative to the extremely low starting current of certain alternating current meters, used very largely in America with great satisfaction.

I must admit that, in common with those of other countries, lighting engineers in America have had the same complaint to make as to some meters starting with no load, as mentioned by Mr. Holden and also by Mr. Clothier, in your issue of June 12th.

With their cause, as found in the employment of jewelled or other mechanical contact bearings, and commutators, and the necessarily consequent devices for adjustment, these complaints have been removed with respect to the meters to which I made reference.

The shortcomings of some should not, in justice, be charged up against all, either in England or America, and it may be that in the products of other countries, besides America, may be found some meters to perform as badly as those that have led the two gentlemen mentioned to form the opinions they seem to hold.

Wm. C. Anderson,
Engineer, Stanley Instrument Co.

Paris, France,
June 25th, 1903.

BUSINESS NOTES.

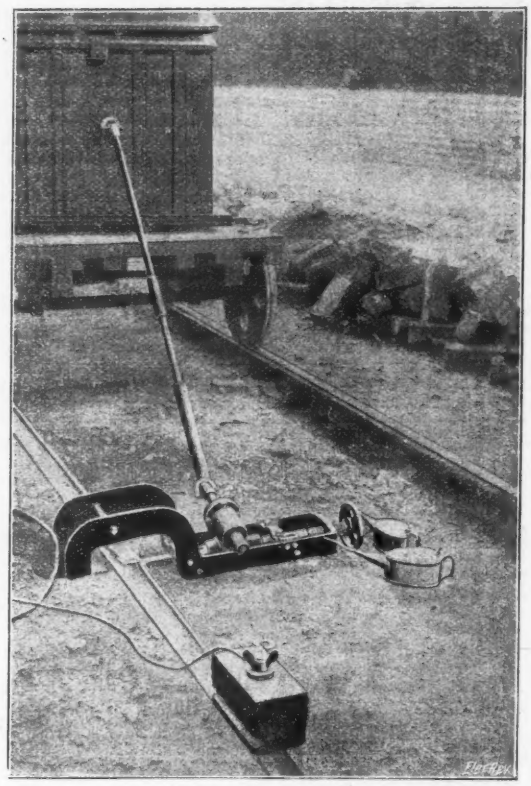
Electrical Wares Exported.

Week ending July 1st, 1902.		Week ending June 30th, 1903.	
Adelaide	Value £63	Adelaide	Value £17
,, Teleg. cable	54	Alexandria	23
Alexandria. Teleg. mat.	328	Amsterdam	126
Amsterdam	37	Auckland	80
Boulogne	140	Bangkok	40
Calcutta	195	Bombay	29
Cape Town	251	,, Teleg. mat.	178
Fremantle	59	Buenos Ayres	111
Hamburg	169	Calcutta	466
Melbourne. Teleg. wire	1,320	,, Teleg. mat.	784
Nagasaki	312	Cape Town	2,035
Shanghai. Teleg. apparatus	9	Constantinople	105
Sydney	545	Delagoa Bay	121
		Durban	nil
		,, Teleg. mat.	338
		East London	325
		Hamburg. Teleg. mat.	970
		Hobart	900
		Lisbon. Telephones	42
		Melbourne	206
		Montreal	42
		Ostend	40
		Perth	322
		Port Elizabeth	30
		Rotterdam	18
		San Sebastian	38
		Santander	20
		Shanghai	27
		Sydney	102
		,, Teleg. mat.	57
		Yokohama	108
Total	£3,482	Total	£7,790

Foreign Goods Transhipped.

Gothenburg. Elec. appar.	Value £40	Auckland. Elec. mat.	Value £16
		East London. Elec. mat.	9
		,, Telephones	170
		Melbourne. Elec. mat.	18
		Total	£213

Tram Track Drilling Machine.—The accompanying illustration shows an electric track-drilling machine for use on tramways. It was designed by Mr. A. N. Banister, the engineer and manager of the Norwich Electric Tramway Co., after having experienced the need of some such machine for use on the Norwich tramways. The machine was specially designed so that the company could carry out their own repairs. Experience has shown it to be an exceedingly useful tool, and on one occasion it drilled 19 one-inch tie rod holes through the web of the rails in 40



View of Track Drill at Work.

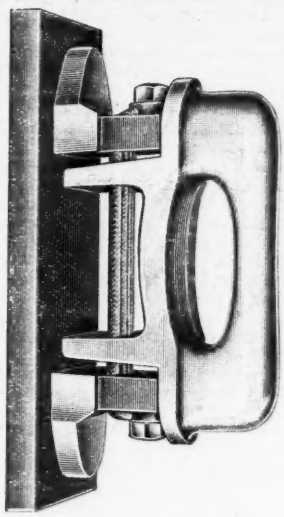
minutes. The machine can be used either vertically or horizontally. The illustration shows it in operation drilling tie rod holes. The motor (7½ H.P.) used was a stock one, but a much smaller machine would do the work equally well and be much handier. Mr. Banister has made arrangements for the manufacture of this machine, and can supply it with telescopic shaft and universal joints as shown, or to be used with a Stow flexible shaft, as may be desired.

Pipe Coverings.—We referred some time ago to tests of certain pipe coverings of the class used a good deal in America and put on in finished form. No plastic tests were then given, and the information has been supplemented by Messrs. Snowdon & Co., of Millwall, who have sent us a pamphlet with tests of their plastic pipe-covering material which they had tested in competition with other coverings. Apparently the various compositions were all of the plastic order, and they show that where a bare pipe condensed 0·878 lb. of steam per square foot of pipe surface per hour with 80 lbs. pressure, the condensation with coverings ranged from 0·295 to as low as 0·204, the thickness of all samples being as nearly as possible alike or 1½ in. when applied, drying down to about 1·4. At 45 lbs. pressure the same coverings allowed condensation to take place, varying from 0·0213 to 0·162 lb. In each case the Snowdon composition shows the best result, but the point is that all show great savings as compared with bare pipe. The tests seem to compare fairly closely with those previously referred to for sectional coverings, and to dispose of the idea that plastic coverings are inferior. Some Russian tests also show very similar results.

Forthcoming Book.—Messrs. Whittaker & Co., will shortly publish "Whittaker's Electrical Engineers' Pocket Book," edited by Kenelm Edgcumbe. The sections in this volume have been written by experts, and will contain information intended to meet the requirements of the various branches of electrical engineering.

Allen's Engines.—Messrs. W. H. Allen, Son & Co., have booked orders for one 80-B.H.P. engine for Messrs. Pilkington Brothers; two 365-B.H.P. and two 150-B.H.P. engines for Londonderry; four 300-B.H.P. engines for Gibraltar Dockyard; four 400-B.H.P. engines for Messrs. John Taylor & Sons, for the Kola Power Station; and one 500-B.H.P. and one 270-B.H.P. engines for Rotherham. All are to be of their well-known enclosed high-speed compound type.

New Replacement Fuse.—Messrs. Dorman & Smith, of Ordsal Electrical Works, Salford, are putting on the market a new type of replacement fuse for main circuits and general switchboard work. One of these is shown in the illustration below, which needs little explanation. The fuse itself is composed of multiple strands of fine copper wire, each small strand being sheathed in an asbestos casing. This method of construction, we



understand, has been found, after exhaustive trials, to work most successfully. The fuses will open a 500-volt circuit on a dead short, with very little external evidence of the fuse having been blown. As an extra precaution, the substantial porcelain handle has been designed to extend two porcelain walls down to the base, effectually screening the contact blocks from any possible contact with the arc. Messrs. Dorman & Smith are making up power switchboards with their new pattern grip contact circuit breakers on one pole of the generators, and this new replacement fuse on the other, a method which is finding favour with both consulting engineer and user.

Bankruptcy Proceedings.—At the Croydon Bankruptcy Court on June 24th, before Mr. Registrar Fox, Walter Elliott Rossetter, electrical engineer, 14, Elmer's End Road, Anerley, S.E., appeared for his public examination. His gross liabilities amounted to £971, of which £887 was expected to rank for dividend, while the deficiency was £174. Mr. W. Hood appeared for the trustee. Debtor stated that for 12 years before the receiving order was made he had been clerk to an engineering firm, his salary for the last three years having been £187 3s. per annum. From March to November, 1901, he was interested in an instrument known as Rossetter's electro-magnetic and carbon microphone, and trading with a partner as the Eastern Electric Co. at 17, York Terrace, Clapham. Debtor's wife was scheduled as an unsecured creditor for £470, stated to have been lent to him by her. The premises in which debtor was living were stated to belong to his wife, subject to a mortgage, and Mrs. Rossetter also claimed the household furniture. The examination was adjourned.

Dissolution.—The Special Telephone Directories, Ltd., is winding-up voluntarily, with Mr. F. Cook, of Norfolk House, Lawrence Pountney Hill, E.C, as liquidator.

The Spinthariscope.—This instrument has been invented by Sir Wm. Crookes to demonstrate the extraordinary physical properties of radium. A small quantity of radium is placed in front of a fluorescent screen, and upon examination with a highly magnifying power a scintillating appearance is observed, as if a number of minute sparks were being thrown against the screen. The rays or atoms which are being continuously given out by the radium are rendered visible when they strike the fluorescent screen. It is being supplied by Messrs. R. and J. Beck, Ltd., 68, Cornhill, E.C.

Illuminations for President Loubet.—In connection with the forthcoming visit to London of President Loubet, the French Embassy at Albert Gate will be electrically illuminated on the evenings of the 6th, 7th, and 8th of this month. The installation in question has been entrusted to Messrs. John Barker & Co., Ltd., of Kensington, who will also be responsible for the interior lighting of the Embassy during the period of the President's visit. The illumination works, which comprise an installation of approximately 1,500 "Ediswan" lamps, are being personally supervised by the company's engineer, Mr. C. T. McKinlay, A.M.I.E.E., and are being carried out with wooden battens, recessed to receive the ordinary S-type holders, and painted to resemble the walls of the building.

For Sale.—Two gas engines and dynamos, 140 amperes at 100 volts, and 60 amperes at 135 volts, and certain apparatus, are offered for sale by Messrs. Massey & Allpress on behalf of a City bank. See our advertisement pages to-day.

Messrs. P. Huddleston & Co. will, on July 13th, offer for sale by auction the plant, stock and machinery of the Lonsdale Motor Co., Ltd. (in liquidation). See our advertisement pages for particulars.

The Steam Turbine.—The Westinghouse Companies are at present building for the Underground Electric Railway Co., Ltd., of London, eight 8,000-H.P. engines, capable of giving continuously an overload of 50 per cent., or 12,000 H.P. in all. For the Neasden power house of the Metropolitan Railway, there are also under construction three units of 5,000 H.P. each. The most recent important turbine order secured by the British Westinghouse Co., is for six steam turbines of 2,000 KW. each. These will be installed in the two power houses in the Clyde Valley Electric Power scheme, taking the place of cross-compound Corliss engines as originally contemplated. More recently still one of the largest American contracts for electrical power machinery has been placed with the companies. This is for the electrical equipment of the Philadelphia Rapid Transit Co., and covers 15,000 KW. of steam turbine, and approximately 50,000 KW. of electrical generating and converting machinery for the new Rapid Transit Subway and Elevated System of Philadelphia. The most interesting feature of the plant is that steam turbines are to be used exclusively for power generation in the new central station, now under construction. Three units will be installed, each of 5,000 KW. and of the type now being built by the Westinghouse Machine Co. for large powers. The turbines will be direct-connected to Westinghouse three-phase generators, running at 25 cycles and 750 revolutions per minute, with steam at 175 lbs. pressure, and 27½ in. vacuum, and probably 100° to 150° of superheat. The alternators will run in parallel on common bus-bars, and power will be distributed directly at a normal pressure of 13,000 volts, without the use of transformers. The power station will be located upon the Delaware river, and is laid out for an ultimate capacity of 50,000 KW., it being the idea of its designers to concentrate at this point the entire power generating equipment, which is at present distributed among a number of small stations. The position chosen secures excellent coaling facilities and an inexhaustible supply of water. Several sub-stations will also be erected where the high pressure alternating current will be converted into low pressure direct current for use upon the third rail of the traction system. The first installation will comprise 14 1,000-KW. Westinghouse rotary converters, and two 500-KW. rotary converters. Each of the 1,000-KW. rotaries will be fed by three 375-KW. step-down transformers, and each of the 500-KW. rotaries by three 175-KW. transformers, that is, one for each phase, suitably arranged. The new Rapid Transit system, which is now under construction, will cover the entire business district of Philadelphia, and will include a two and four-track subway about 1¼ miles in length. The enterprise is one of the most important in the history of American railway development, and the introduction of the steam turbine in such large sizes in that country is particularly gratifying by reason of the confidence shown in this type of prime mover, of wholly British origin. The engineers for the above scheme are Messrs. Westinghouse, Church, Kerr & Co., who represent the engineering branch of the Westinghouse industries in America.

Cheap Electric Light.—We have received from Mr. D. F. Lang, of 146, Norfolk Street, Glasgow, a pamphlet dealing with the relative merits of gas and the electric light. He appends the following comparison of costs between gas at 2s. 6d. per 1,000 cubic feet, and electric light at 6d. for the first 365 hours and 1d. per hour after—Glasgow rate. Both are supposed to give the same amount of light, while the gas consumption of a No. 6 gas burner is 6 cubic feet per hour, and that of a 16-C.P. (electric) lamp is 60 watts This works out in 1,095 hours' (about a year's) burning as follows:—

THREE HOURS PER DAY.

Gas.

First 365 hours, No. 6 burner—										
865 × 6 = 2,190 ft. at 2s. 6d. per 1,000					..	..	..	..	£0	5 6
Second	do.	do.	do.	do.	..	..	..	..	0	5 6
Third	do.	do.	do.	do.	..	..	..	..	0	5 6
1,095 hours					..	..	..	..	£0	16 6

Electric Light.

First 365 hours, 16-C.P. lamp—										
365 × 60 = 21,900 at 6d. per 1,000					..	..	..	..	£0	11 0
Second	do.	do.	at 1d.	do.	..	..	..	..	0	1 10
Third	do.	do.	do.	do.	..	..	..	..	0	1 10
1,095 hours' light					..	..	..	..	0	14 8

Showing a saving to the electric light account of 1s. 10d. per lamp, or burner; to 10 burners, 18s. 4d.; 20 burners, 36s. 8d.

Books Received.—"Modern Locomotive Practice," by C. E. Wolf. Manchester: The Scientific Publishing Co. Price 10s. 6d. net.

"Annual Report of the Council of the City and Guilds of London Institute": Gresham College, Basinghall Street, London, E.C.

"Electrical Engineering," by E. Rosenberg. London and New York: Harper Bros., 45, Albemarle Street, W. 1903. Price 6s.

"Telephony," Vols. i., ii., iii., by Arthur Vaughan Abbott. New York: McGraw Publishing Co. Price $1.50 each. (The set of six vols. $6).

Annual Outing.—The employés of the London Electrical Fittings Co., Ltd., held their ninth annual outing at Egham, on Saturday last, in excellent weather. A large party travelled down from Waterloo, under the supervision of Mr. F. Denning. In the morning, sports were held in the grounds, and these were followed by a dinner and concert at the King's Head Hotel.

A Curiosity in Specifications.—We have had lent to us a copy of the specification recently issued for the electric light installation at Eastley Sanatorium, and can commend its purchase (for the sum of one guinea) and perusal by any electrical contractor who, having spare cash at his disposal, desires a specially risky investment. He will find an opportunity of tendering for the wiring of 142 incandescent lamps to be of approved English make, using Glover's 600-megohm grade cable, Henley's flexible, and Tucker switches. The switchboard and distribution boards he may offer to make himself, but can only do so if approved by the engineer. In the power house he must instal a battery of a particular size made by the E.P.S. Co., purchase a certain dynamo from Mr. Wilson Hartnell, procure a definite length of "Hendry's" belting, and reserve the sum of £430 to cover the cost of oil engine, motor, trenching work and contingencies, as directed by the engineer. We do not deny that the specified makers are thoroughly experienced and of high repute in their particular branches of the industry, but where in carrying out such an installation does the contractor come in? He merely supplies the labour and gets a bare merchant's profit on a few items. And yet he is to take every responsibility for the satisfactory working of the whole of the plant, maintain it for six months against damage, and submit to the withholding of 20 per cent. of the contract price for periods varying from two to six months. In all probability the retention money more than represents the value of the work actually done by him, yet he cannot claim any part of it until the plant he had no part in selecting works for two months to the satisfaction of the engineer who chose it, and who is the *sole arbiter* in cases of dispute. The requirements are not, in our opinion, just, the engineer should specify *ends* and allow the contractor to select the *means*, and we are glad that the vast majority of consultants are now acting on these lines, and that specifications like the one before us are becoming so rare that we are justified in classing it as a curiosity rather than an intended basis for an actual business contract.

An American Joke.—We have just learned a thing that some have often feared would come to pass—that the British Isles no longer have existence. The news is American in origin, so that there can be no doubt as to its truth. Furthermore, the British Colonies are very much in evidence, but they are bereft of the Motherland, and are led to seek shelter under the wings of the U.S., for all the world like an old clucking hen calling another's chickens together. We do not read this statement in so many words, but the Pennsylvania Steel Co. has had the audacity to send us a copy of its map of the world with the British Isles deleted—lost in the recent rains perhaps? A couple of years ago it supplied the Gokteik Viaduct in Mandalay, and lets the world know all about it in an illustrated *brochure*, "From Steelton to Mandalay," a sort of characteristically Yankee "lick-creation" story. The map shows the route followed in the conveyance of the construction from Steelton Works to its destination, and while it shows such places as Iceland, Tasmania, Madagascar, and many even less important places, it wipes out these poor little islands as with a sneer of contempt. It is the kind of insult that some indiscreet U.S. traders are committing every day in their excessive pushfulness. We should like to think that the omission was only an error, but it is too strange and remarkable for that. The incident may afford our manufacturers some little amusement, though it is an exceedingly poor joke if such it is intended to be.

Catalogues and Lists.—The London Electric Wire Co., Ltd., has issued, in convenient folding pocket form, a new set of wire tables giving weights, resistances and current capacities of annealed copper wires of various sizes; also details of "Eureka" resistance wire; a list of wire gauges in common use, and other useful data.

The Lahmeyer Electrical Co., Ltd, have issued another of their brochures; it illustrates their continuous-current high-speed machines.

Messrs. Bray, Markham & Reiss, Ltd., of Blackhorse Lane, Walthamstow, have brought out a price list of their B.M.R. double-pole switches and motor starters. Their switch is claimed to be completely protected, "fireproof and foolproof."

A taking show card has been got up by the Edison & Swan Co. as an advertisement of the Royal Ediswan lamp. It is evidently intended as a wall showcard for the premises of retailers and general purchasers.

The Union Electric Co., Ltd., of 151, Queen Victoria Street, E.C., is now issuing several further illustrated pamphlets relating to its electrical instruments. They describe respectively, the "Union" standard "S" type of portable ampere-meters and volt-meters for direct and alternating currents; the "P" type ditto for direct current; the "P" type electromobile instrument, consisting of dead-beat amperemeter and voltmeter combined in one frame; and the "P" type (moving coil) demonstration galvanometer.

A Waterproof Motor.—We had an opportunity last week of inspecting a real waterproof motor at the Electrical Co.'s establishment in Charing Cross Road. Any motor can be made *water-tight* by enclosing it, but the motor we saw was not enclosed. It was one of the Electrical Co.'s ordinary standard four-pole open type. For two months (since April 22nd) it has been fixed in the open air on the flat roof of the company's building, and residents in London need no reminder that we have had our full share of rain during that period. The motor seemed none the worse for it. It is connected to a 200-volt supply, and started up on switching on just as it might under the best possible conditions. Whilst running, an attendant threw two bucketfuls of cold water on to the commutator and windings. The only effect was to make it more silent, that is, the characteristic squeak of the carbon brushes ceased for a time until the water had all run off. The motor was running light, but at our request it was loaded up by applying a brake to the pulley, and another bucketful of water was then thrown over the machine.

Whilst wet we asked that the insulating resistance of the motor should be measured. This was done, the reading being 300,000 ohms. In order to test the sparking limit, we asked that an ammeter should be connected in circuit. This was done. The motor was a standard 7-H.P. 200-volt shunt machine, so its full load current should be about 30 amperes.

Unfortunately, we could not get more than 38 to 40 amperes on with the brake, and at this current there was absolutely no sign of sparking, notwithstanding the unusual treatment to which the motor had been subjected. The light load current was 2 amperes. The only effect we could discover that the water had had on the motor was to interfere somewhat with the oiling of the commutator end bearing. The oiling ring appeared to be coated with an emulsion, and inclined to stick. This, the attendant explained, was due to his having left the bearing cap off, so that, on throwing water over the machine, the bearing filled up with water and washed the oil out. The bearing at the pulley end was no worse for its exposure and shower baths. The company has expended much care and trouble on insulation, and its claim to have found a method of insulating the coils in a manner which shall render them waterproof would appear to be absolutely justified. Each coil is tested at a pressure of 2,500 volts before leaving the works. The armatures are former wound, and, of course, slotted.

The rating of the standard machines is such that, in a continuous six hours' run at full load, the temperature of the semi-enclosed machines will not exceed 80° F. above the surrounding atmosphere. Up to the 10-H.P. size they will stand overloading 25 per cent. for an hour; larger machines for two hours. The brush gear is very neat, certainly one of the best and simplest designs we have seen for a parallel feed. The terminals are protected by a metal hood, and all parts are made to gauge and strictly interchangeable. We understand that the motor referred to will be kept in the open until it breaks down, and inspection at any time is invited.

Trade Announcements.—Messrs. Moores, Farrell and Co., of Mynshulls House, Victoria Street, Manchester, have purchased the goodwill of the business of electrical engineers heretofore carried on by Messrs. Wilson & Orr, at Ellesmere Electric Works, 46, Ellesmere Street, Cornbrook, Manchester. They have engaged Mr. Wilson to act as works manager, and will continue the business on the same lines at 46, Ellesmere Street. Messrs. Moores, Farrell are manufacturers of switchboards, switches, fuseboards, watertight fittings, and general electrical accessories, and all communications should be addressed to them at Mynshulls House.

The General Incandescent Arc Light Co. announce that, in addition to the offices, warehouse and showrooms at 115—117, Cannon Street, E.C., now occupied by their representative, Mr. A. H. Hunt, they have engaged temporary offices and showrooms on the third floor in the same building, where inquiries may be addressed. Circulars of "Paragon" motors, enclosed arc lamps, and other specialities may be obtained on application.

Mr. Leonard Andrews, joint managing director with Mr. C. J. Cowan, of the Key Engineering Co., returned last week from a six-weeks' trip to the United States. We learn that the primary object of Mr. Andrews' visit was to assist the Stanley Manufacturing Co. in the development of the U.S. patents, which were acquired by that company last year. He has also succeeded in transacting a considerable amount of other business, both in introducing English engineering specialities in the American market, and in the obtaining and handling of several American novelties, which will shortly be put on the English market by the Key Co. Mr. Andrews is resigning his appointment of consulting engineer to the Hastings Corporation, and he will be able to devote his entire attention to the management of the Key Co. in the Manchester and northern district. Mr. Cowan will look after the company in the London and southern district.

Peru.—Mr. Eduardo Higginson, Consul of Peru, of 10, Canute Road, Southampton, has sent us, at the request of D. E. Larrabure y Unánue, Minister of Foreign Affairs, a copy of a new map of the Republic of Peru which has just been published. Some descriptive notes respecting the country and its various industries are given, in the hope of making known the inducements which Peru offers for capital, immigration and colonisation.

Exports of British Electrical Machinery.—The exports of British electrical machinery during May last attained a value of £38,799, bringing up the total for the first five months of the year to £186,348.

ELECTRIC LIGHT AND POWER NOTES.

Aston.—The electricity station is nearing completion, and the E.L. Committee has decided to charge 6d. per B.T.U. between the hours of 5 and 7 at night in the winter and 7 and 9 in the summer, and 1½d. during the remainder of the day. It has been decided to erect six public arc lamps as an experiment.

Asylum Installation.—The lighting plant at the new lunatic asylum, erected by the Croydon Corporation at Chelsham, consists of two Bellis non-condensing engines, dynamos and

booster set by Messrs. Mavor & Coulson, of Glasgow. The storage battery was supplied by the Chloride Electrical Storage Co., of Manchester, and the switchboard by Messrs. Frank Sufer & Co., of London. The electric wiring was executed by Messrs. Wenham and Waters, Ltd, of Croydon, and the total cost of the electric lighting arrangements has been £6,000, the total cost of the asylum being close on a quarter of a million. Mr. E. F. Rivers acted as consulting electrical engineer.

Barnsley.—The accounts of the municipal E.L. department show that last year a net profit of £291 was made.

Barnstaple.—The E.L. Committee has recommended that application be made to the L.G.B. for the balance of the £27,000 previously asked for in respect of the local scheme.

Bedford.—The E.L. Committee recommends the Council to obtain a further loan of £6,960 8s. 8d.—for house connections from September 30th, 1902, to March 31st, 1903, £700; mains extensions, £539 8s. 8d.; contracts in hand: steam alternator, £3,070; high and low tension cables, £1,095; water-tube boiler, £1,556; and that the engineer obtain three oil pumps for the engines at a cost of £15 each.

Bournemouth.—The Bournemouth and Poole Electricity Supply Co. has decided on a substantial reduction in the price of electricity, commencing on the first of this month.

Bradford.—The Drapers' Association has addressed a letter to the E.L. Committee calling attention to a recent resolution of the former body condemning the charges for electricity as excessive, and asking for a reduction in price. It is pointed out that many consumers use the light all day, but get no reduction as in the case of power users.

Burnley.—The Electricity Committee has recommended the T.C. to add to the plant at the electricity station a new engine and dynamo of 250-KW. capacity, at an estimated cost of £4,000, new generator panels for the traction switchboard at a cost of £105, and that a loan of £9,606 7s. 8d. for electricity purposes should be applied for.

Canada.—The Canadian Pacific Railway Co. has equipped 100 locomotives with a new type of electric headlight which, in addition to projecting a horizontal beam, also projects one vertically as an indication of the movements of a train.

Chatham.—The report of the Chatham, Rochester and District E.L. Co. shows a substantial increase in the revenue of the company. The surplus for the year ending December 31st, 1902, is £1,799. The sale of the undertaking to the Kent Power Co. has not yet been completed.

Colliery Installation.—Some great improvements are taking place at Messrs. Bolckow, Vaughan & Co.'s Auckland Park Colliery. An electric power station is being put down, and electric hauling engines will bring the "setts" of tubs outbye to the shaft, and the coal-washer, screens, apparatus, &c., will be worked electrically. The only steam used, will be for the winding engine which brings the cages to bank. Similar plant has just been put down at the company's Binchester and Western collieries.

Coventry.—The Council has sanctioned a recommendation from the Electric Light Committee that application be made to the Local Government Board for sanction to a loan of £5,000 for the purchase of electric motors to be let out on hire. It was explained that the demand for these motors showed a steady increase, and that the Council had previously sanctioned £2,000 being spent in this way.

Crewe.—The T.C. has decided to oppose the North-Western Electricity and Power Gas Co.'s Bill.

The electric light consumers, being dissatisfied with the free wiring system under the Free Wiring Co., have decided to inform the T.C. that they will only pay as rental 1s. per point per annum. Owing to the large profits made, the Corporation has been asked to reduce meter rents.

Dover.—Official trials of the two new electric cranes which have been installed here at a cost of £11,000 to command both sides of the Admiralty Pier, took place on June 26th. They have been designed by Sir Wm. Preece, and made by Messrs. Siemens, for the Dover Harbour Board. The cranes are to be used for the transhipment of mails and baggage in specially-built crates capable of containing 2½ tons. Under the new system, which was to come into operation on July 1st, coincident with the advent of the turbine steamer, a great saving of time will be effected, from the fact that the crates will be loaded up in London and Paris, and carried straight through to either capital. Electrical cranes have also been erected at Calais.

East Barnet.—The District Council has decided to engage an expert to report upon a letter from the Power Distribution Co., and other matters connected with the proposed scheme for electric lighting.

Finchley.—The station buildings for the District Council's electrical undertaking are being rapidly completed. It has been resolved to charge 4½d. per unit for lighting and 2d. for power.

Folkestone.—The T.C. on July 24th discussed a proposal to purchase the undertaking of the local Electric Light Supply Co., but it was decided that it was inopportune at present to entertain the matter.

Gillingham.—The U.D.C. has offered to supply electricity to the Royal Engineers' Brompton Barracks on the same terms as charged to the Admiralty for the Naval Hospital.

Gloucester.—The report on the last year's working of the electricity department shows that the number of 8-C.P. lamps connected up is 22,680, an increase of 31 per cent. There is a gross profit of £2,215, and after meeting financial charges a deficit of £1,137. The T.C. has decided to apply to the B. of T. for an extension of the area of supply.

Gravesend.—The T.C. has applied to the L.G.B. for a loan of £1,479 for electricity purposes.

Hanley.—The T.C. has adopted a recommendation of the E.L. Committee to borrow £5,000 for necessary extensions.

Hitchin.—The U.D.C. has sealed an agreement with Messrs. Crompton & Co., Ltd., for the leasing of the Council's E.L. order.

Lancaster.—The T.C. has received from the L.G.B. sanction to borrow £25,000 for E.L. purposes.

Limerick.—The B.C. has given notice that during June and July a reduction of 50 per cent. will be made to consumers of electricity, on the ordinary prices charged by the Council, viz, 5d. for light, and 3d. per unit for power. Also a discount of 33⅓ per cent. will be allowed off the first quarter's accounts of all consumers connected up by August 15th next.

London.—BATTERSEA.—Arrangements were made by the B.C. on Wednesday, to provide, at an estimated cost of £1,920 12s. 6d., electric light fittings for the working-men's dwellings, recently erected on the Latchmere estate.

CAMBERWELL. — The B.C. has had under consideration the decision of the Board of Trade not to sanction the application of the London Electric Supply Corporation, Ltd., for an extension of its area over the southern portion of the borough, so as to include the entire borough. By the refusal to grant the application of the London Electric Supply Corporation, Ltd., for a competitive supply throughout Camberwell, which refusal, it is maintained, is contrary to the practice that has hitherto been pursued by that department in London, the Board has given to the County of London and Brush Provincial Electric Lighting Co., Ltd., a monopoly over the southern portion of the borough, and consequently the ratepayers will not be able to avail themselves of the advantages of the lower charge which is made for electricity in Camberwell where such competition now exists.

HACKNEY. — The report on the past year's working of the E.L. department shows that there are 68,897 8-C.P. lamps, including 98 motors of 380½ H.P.; 1,943,983 units were generated, 1,075,962 being for private lighting, and 539,006 for public lighting. The works costs are 1·03d. per unit sold, being a record for the London district. The total revenue was £21,368, and the gross profit £13,543, the net surplus of £2,253 has been transferred to the reserve fund. The net cost of refuse destruction, after crediting the electrical department with heat to the value of £2,272, and £8 sundries, was £5,019, or 2s. 11½d. per ton.

HAMMERSMITH.—The Lighting Committee has reported that Mr. A. H. Preece has been instructed to prepare the necessary drawings and specifications to complete the original scheme in connection with the obtaining of water from the Thames for condensing purposes. The main item of the work in question is the fixing of a rather large pump. A Burroughs Adding machine is to be purchased on the recommendation of the electrical engineer. The Law and Parliamentary Committee recommend that consent be given to the proposal of the L.C.C. to construct a tramway from Shepherd's Bush to the Marble Arch, and that one-third of the cost of the necessary street widenings be paid by the Borough Council.

HAMPSTEAD.—At the meeting of the B.C. it was agreed that, having regard to the suggestion made by the factory inspector as to the necessity for enlarging some of the street transformer stations, one station should be altered first as an experiment, in accordance with the plan submitted by the electrical engineer, at an estimated cost of £60.

MARYLEBONE.—The Electricity Committee, failing to obtain the sanction of the L.C.C. to the loan required for electric lighting purposes, are now in favour of applying to the Board of Trade for a license to authorise the Borough Council to supply electricity in Marylebone. Such a license would remove the difficulty, the existence of which is the County Council's excuse for refusing to sanction the loan. The Committee are also in favour of appealing to the Local Government Board against the decision of the L.C.C. not to sanction the loan. To make things trebly sure they are in favour, in the event of the Government departments not communicating their decisions by the end of September, of giving notice of the Council's intention to apply to Parliament for such statutory powers as may be found necessary to amend the present Act. As Mr. Asquith has advised that it is not possible to set aside or modify the award of the umpire in the arbitration between the company and the Council, only one course appears to be open to the Council—to take over the electric light undertaking at the very heavy price fixed.

PADDINGTON.—The Electric, Gas and Water Committee of the B.C. has invited the Metropolitan Electric Supply Co. to tender for the lighting of four miles of the Harrow and Edgware Roads.

POPLAR.—The Lighting Committee of the B.C. has drawn up the following rate of charges for maximum demand:—Lighting, 5d. per unit for the first 90 hours', use of the "maximum demand" per quarter, 3d. per unit for all subsequent consumption during the same quarter; power, 3d. per unit for the first 90 hours' use of the "maximum demand" per quarter, 1½d. per unit for all subsequent consumption during the same quarter. The existing rates of discount are to remain in force.

WESTMINSTER.—In a report issued recently, the Works Committee stated that an arrangement had been come to with the Charing Cross and Strand Electricity Supply Corporation regarding the erection of a street box in the Strand, by Wellington Street, in respect to which summonses were heard at Bow Street on June 11th and adjourned for one month. It was further reported that an agreement had been arrived at with the Postmaster-General respecting the laying and maintenance of telephone wires, and that all legal proceedings had been withdrawn.

STEPNEY.—An extensively-signed petition has been presented to the B.C., protesting against the bad lighting of some of the streets. The present system of lighting by arc lamps is condemned as "very unreliable and inefficient, and a source of danger to the residents, as the vice-chairman of the Electricity Committee can testify."

Londonderry.—Mr. Macrory, the E.L. engineer, has presented a comprehensive report on the development of the E.L. undertaking, and it was resolved that it should be printed and circulated, consideration being deferred.

Loughborough.—After negotiating with the Leicester and Warwickshire Power Co. (who proposed to supply energy at 1¾d. per unit), and the Empire Electric Power Co., the T.C. has adopted the recommendation of the Committee to carry out its own scheme for electric lighting, the Gas Committee being appointed to recommend a scheme for adoption.

Malton.—The Highways and Lighting Committee of the Urban Council reported that it has had a communication from the Board of Trade, asking for its observations on a letter from the Northern Counties Electric Supply Co. The Committee was not satisfied with the letter of the company and the undertaking given, and suggest that the Board of Trade be asked to direct the company to carry out the terms of the order granted them within a reasonable time, or that the Board revoke the order. It was suggested that the company were playing with the Council, and the latter had better "go for the penalty" provided by the E.L. Act. The order granted to the company directed that the light was to be available by July 31st, 1902, and there was practically nothing done. The penalty named was £5 10s. per day, and they ought to enforce it, as the company had failed to provide a proper supply.

Manchester.—The returns of the E.L. and Power Department for the year ending March 31st, 1903, show that the total revenue was £197,169, and the working expenses £112,316, leaving a gross profit of £84,853, and after meeting financial charges, a surplus of £8,311, which has been carried to the reserve fund; 19,400,223 units have been sold, the average price being 2·68d. The capital expenditure amounts to £1,713,627.

Mansfield.—The E.L. Committee has recommended that the light be supplied free until the 24th inst.

Metropolitan Asylums Board.—At a recent meeting of the Metropolitan Asylums Board, the Works Committee submitted a report with regard to the installation of electric light at the Board's Southern Hospital at Carshalton. There had been some correspondence between the engineer to the Board and the County of Surrey Electric Power Distribution Co., the company having offered on certain conditions to supply energy to the institution, without stipulating any minimum quantity, at the rate of 3d. per unit. It would be necessary to provide a small sub-station for the distributing apparatus near the hospital entrance. The Committee being of opinion that the company's offer would overcome the difficulty of laying down an expensive plant, recommended that the offer be accepted.

Oldham.—At the opening of the new electricity generating station at Greenhill, Oldham, the Mayor (Alderman Hanson) presided, and the opening ceremony was performed by Alderman Harrop (chairman of the Electricity Committee), to whom was presented a handsome key, engraved with the arms of the borough. Among those present, in addition to local gentlemen and the resident engineer, Mr. S. W. Newington, were Dr. Kennedy, F.R.S. (consulting engineer), Mr. C. Stanley Peach (architect), and Mr. Alexander Siemens (Messrs. Siemens Bros. & Co.). Following this, Dr. Kennedy briefly described the works, and Mr. Peach described the buildings, which were said to form one of the most modern and well fitted central stations in England.

After repeated enlargements of the Rhodes Bank generating station, it became necessary for the Corporation in 1900 to seek for a site for a new station, the demand for energy both for lighting and traction having increased greatly. The Greenhill site, with an area of about 112,700 sq. ft., was chosen. The building is designed to cover practically the whole area, but is arranged so that it may be built gradually, each section forming a complete generating station. The present buildings will contain plant having a total capacity of about 11,000 H.P., and if extended according to present proposals, the total capacity of the complete station will be approximately 20,000 H.P. The plant now installed totals 6,000 H.P.

At a dinner held in the Town Hall at night, Alderman Harrop, who presided, replied to the criticism of those who had said the new station would be a "white elephant."

Peterborough.—A L.G.B. inquiry has been held into the application of the T.C. for sanction to borrow £5,000 for E.L. purposes. There was no opposition.

Ramsgate.—The T.C. has rescinded its resolution of the 8th ult., with reference to the offer of the National Free Wiring Co., Ltd., to carry out the electric lighting of the town, and also the proposed application to the L.G.B. in connection therewith. The Corporation prov. order expires on the 13th inst.

A special meeting was held on Friday last to consider the revised offers for leasing the Corporation's E.L. order, submitted by Edmundson's Corporation and the Isle of Thanet Light Railway and Electric Light Co. The former offered to form a Ramsgate Electric Light and Power Co., which would find the capital, and supply electricity to private consumers at 7d. per unit for the first hour per day, and 2d. afterwards; for power and street lighting at not exceeding 2d.; and to establish a free wiring system at a rental of 4½d. per lamp per quarter. The Tramway Co. offered to supply energy at 6½d. per unit for the first hour, and 2d. afterwards, or as an alternative, at the option of the Corporation, at 6d. and 2½d. The offer of the Tramway Co. was accepted.

Salford.—The annual report of the borough electrical engineer states that new connections were made during the year equivalent to 16,830 8-C.P. lamps, and 517 H.P. in motors. The change of voltage in connection with the conversion from alternating to direct current has been completed, the expenditure on this work during the past 12 months being £2,681. The total cost of the change was £6,818. Motors are now hired out to consumers with a view to developing the demand for electricity for power purposes, and 39 motors have already been fixed, totalling 336 H.P. The expenditure on capital account during the year amounted to £102,247, the principal items being, mains £64,831, machinery £25,105, and buildings £10,242. This additional expenditure represents an increased annual capital charge of about £6,250. The total capital expenditure to March 31st last amounts to £487,706. The income has increased by £27,632—from £17,592 to £45,224—but the working costs have only increased £4,843. The capital charges show a total increase of £11,969. The deficit on the year's working has decreased from £13,214 to £2,394, and would have disappeared altogether but for the expense involved in changing the pressure of supply. The total number of units generated amounted to 5,804,861. Of this 3,370,434 units were sold for tramway purposes, and 159,328 for street lighting, as compared with 458,380 units for tramway purposes and 19,271 for street lighting in the previous year. The units sold to ordinary consumers for lighting and power purposes have gone up from 795,107 to 1,242,861. The units taken for power purposes amount to 334,507. The number of consumers has increased during the year from 561 to 714, and the number of 8-C.P. lamps connected has increased from 73,743 to 90,573. The total horse-power of motors connected amounts to 1,005 H.P., as against 488 H.P. the previous year.

Sale.—An electrical exhibition promoted by the U.D.C. has been opened at the Free Library.

S. Africa.—The report of the Rand Central Electric Works, Ltd., for 1902, states that the prosperity of the company has been adversely affected owing to the mines having been unable to resume operations to their full capacity. The accounts show a gross profit of £14,188, and, after deducting the amount of £11,950 set aside for depreciation, there remains a net profit of £2,238, which reduces the debit balance of £25,231 brought forward on December 31st, 1901, to £22,993. The total power distributed during the year was 7,123,720 KW.-hours. The total revenue from all sources was £52,964, as against £8,523 for about three months of 1901, and the working expenses, including depreciation, £50,725, as compared with £26,809 for the preceding year. The receipts derived from the supply of power aggregated £52,469, as against a revenue of £7,869 from the same source during 1901.

Spain.—A Decree has been granted to Don Altarriba Baron de Sangarren for the establishment of a hydro-electrical installation on the River Garova, in the province of Larida, for driving paper factories in the neighbourhood.

Swindon.—The electricity supply works recently erected by the Corporation were formally opened on Wednesday, although the authority has been supplying electricity since May 30th. The works are designed for supplying light and power, provision being made for the necessary extensions which will be required when the proposed tramway system is completed. The building is of red brick, and is thoroughly well equipped with the usual offices, test room, &c. In the engine room there are three 350-I H.P. Browett-Lindley triple-expansion engines coupled to Siemens 250-KW. dynamos running at 450 revolutions, and supplying the three-wire system, with 440 volts across the outers. There is also a balancer, motor-generator, and condensing plant. The switchboard is by Messrs. Bertram Thomas. The battery is of the Tudor Co.'s make, and consists of 252 cells with a capacity of 350 ampere-hours. The boilers are of the Lancashire type, by Messrs. Tinker, Shenton & Co., and are 30 ft. × 8 ft., and constructed for 180 lbs. working pressure, and are fitted with Proctor's mechanical stokers, driven from an overhead shaft and motor. The pump room is fitted with two Hall boiler feed pumps of 2,500 gals. capacity each, and a large feed tank is provided for storage. Near by, at the rear, is the cooling tower, which will deal with some 60,000 gallons per hour. A 12½-ton crane is provided in the engine house. At present there are about 6½ miles of mains with three feeding pillars. The meters are of the

Chamberlain & Hookham type. The mains were supplied by Messrs. W. T. Glover & Co. The consulting engineers are Messrs. Lacey and Sillar, Westminster, and the resident engineer, Mr. J. G. Griffin. At the opening ceremony, speeches were delivered by the Mayor, Ald. Skurray, Lord Edward Fitzmaurice, M.P. for Swindon, &c.

Todmorden.—The T.C. has decided to forthwith have plans and specifications prepared for an E.L. scheme for the borough.

Tonbridge.—The Board of Guardians propose to have the electric light installed at the Workhouse in place of gas, and the Tunbridge Wells T.C. has been asked for terms for the supply of energy.

Wallasey.—The Electrical Committee has had its attention called by the engineer to the practice at present adopted, whereby applicants for the laying of electricity mains have first to enter into a deed of covenant guaranteeing to pay 20 per cent. upon the cost of the outlay for a period of three years, together with 10s. stamp duty. The engineer suggested that such practice be discontinued, and that such mains be laid in suitable districts on application being made by six *bond fide* householders. It was recommended that at the next meeting of the Council the standing orders be suspended for the purpose of enabling the Council to carry this suggestion into effect.

A revision of the rates for the supply of electricity has also been decided upon. The charge for energy will will be increased from 5d. to 6d. per unit, with a reduction of 2d. instead of 3d. per unit for all supply above 2 units per quarter for each 8-C.P. lamp; 16 C.P. lamps will have a reduction of 2d. per unit after 4 units per quarter have been consumed. The meter rentals will be:—For 1 to 15 lamps of 30 watts (8-C.P.) each, from 2s. to 1s. 4d. per quarter; 16 to 30 lamps, from 2s. 3d. to 1s. 6d.; 31 to 75 lamps, from 3s. 3d. to 2s. 2d.; 76 to 150 lamps, 5s. to 3s. 9d.; 151 to 200 lamps, 7s. 6d. to 5s. 8d.; 201 to 300 lamps, 11s. to 8s. 3d.

Wimbledon.—The report on the year's working of the E.L. Department shows a net profit of £1,522. 1,011,998 units were sold, 511,152 units being for 1,091 public lamps.

Woolwich.—The B.C. has agreed to the following recommendations of the E.L. Committee:—

(*a*) That a general flat rate of 4d. per unit, less 5 per cent. discount for cash within 14 days, be adopted for lighting purposes in the parishes of Woolwich and Plumstead.

(*b*) That the maximum demand system be continued at the option of the consumer.

(*c*) That charges for the supply of electrical energy for power purposes be adopted, based on the following sliding scale:—Up to 10,000 units, 2d. per unit; 10,000 to 20,000, 1¾d. per unit; 20,000 to 30,000, 1½d. per unit; 30,000 to 40,000 and over, 1¼d. per unit.

(*d*) That special preferential rates be given to consumers whose requirements point to a large consumption at the time application is made.

(*e*) That meter rents be abolished.

ELECTRIC TRACTION NOTES.

Wolverhampton.—The tramways question may be said to have advanced another stage since the last issue of the Electrical Review. Another meeting of the Town Council was held on Monday, this time in public, at which the Deputy-Mayor (who presided) submitted the following resolution for adoption, viz.:—"That the minutes and proceedings of the Council in committee at their meeting held on Monday, June 22nd, 1903, relative to the Lorain system of tramways, be ratified and adopted." Councillor Allen seconded.

It will be observed that the resolution conveys no information whatever, and it was intimated that no discussion would be permitted. Councillor White, however, entered a protest against the Council being thus muzzled; and he was supported by Alderman Price Lewis, who declared that if the opponents of the Lorain system were not to be allowed to make a protest against the course the Council were following, he should challenge the whole legality of the proceedings that day. The alderman was proceeding to substantiate a suggestion that the proceedings were not in conformity with the standing orders, when he was practically shouted down by his colleagues. The town clerk advised the Deputy-Mayor that the proceedings were perfectly formal and legal, and asked him to put the resolution without discussion. Before, however, the vote was taken, Ald. Lewis asked, "Shall we have the minute which you wish to be confirmed, read?" The town clerk said there was no objection to that, and proceeded to hurriedly read the minute, which was to the effect that it be an instruction to the Tramways Committee to arrange without prejudice to either party a conference between the Committee and the Lorain Co., with a view to retain the present track on more favourable terms, and so avoid arbitration.

The Council then divided, with the result that 30 members voted in favour of the confirmation of the minutes, and 14 against. It now rests with a deputation of the Tramways Committee to go cap-in-hand to the Lorain Co. and ask for terms. The period during which the Corporation can, by consent of the company, run the trams, expires this week and there is no telling what may happen then. The feeling is that the company are not disposed to yield and that they *rather* court arbitration proceedings. The difficulty with the Committee is, or was last week, to find a deputation to meet the company. The Committee are themselves so hopelessly divided that the names of two gentlemen—an alderman and a councillor—outside the Committee, have been mentioned as likely to prove successful negotiators with the company. It is understood that the contract with the company has been declared by Mr. Warmington, K.C., and Dr. Underhill, to be so framed that the Corporation could make out a strong and successful case against the company should arbitration be finally resorted to.

Bradford.—While painting a tramway standard, a Corporation employé accidentally touched the electric wire and fell to the ground, receiving serious injuries.

District Railway.—The Metropolitan District Railway on 28th ult., formally opened its new electric railway from Mill Hill to South Harrow, a distance of about 5½ miles, with eight stations.

Holywell.—The R.D.C. on Friday received from a Manchester firm of solicitors, notice of their intention to apply to Parliament, on behalf of a syndicate, for powers to construct an electric tramway over a circular route, with headquarters at Connah's Quay. The proposed line will run from Sandicroft, through Queen's Ferry, Connah's Quay, Flint, Bagillt, Holywell, Northop, Mold, Buckley, Hawarden, and back to Connah's Quay. Current will be supplied by the North-Western Electricity Co. The Council decided to support the scheme to its fullest extent.

Glasgow.—Mr. Bonar Law, replying to a House of Commons question asked by Mr. Weir, states that the Board of Trade are informed by the general manager of the Glasgow Corporation Tramways that the number of accidents which occurred on the Corporation electric tramway system during the year ended May 31st last, causing injuries to persons, was 90, resulting in the death of 24 persons; and that during the same period there were 55 accidents which caused material damage to property. It is added that the number of car-miles run in the 12 months referred to was 14,008,750, and the number of passengers carried 177,179,549.

Light Railways.—Mr. Bonar Law, replying to a House of Commons question put by Mr. Bigwood, says:—"Such delays as have occasionally occurred in proceeding upon applications for light railway orders have been due to postponements of stages for the benefit of parties where conflicting interests have had to be reconciled by agreement. In the majority of such cases these delays have occurred before the Light Railway Commissioners have been in a position to settle the orders and submit them to the Board of Trade. The only way of preventing such delays would be to fix precise limits of time for the several stages, and rigorously to enforce them by the rejection of applications upon failure to proceed within these limits. I do not think this would be advantageous."

London.—The Greenwich B.C. on Wednesday passed a resolution to the effect that, while they offered no objection to the L.C.C.'s scheme for a tramway from Greenwich to Catford, they were not prepared to contribute to the cost of street widenings.

Stepney.—The proposed electrification of the tramways by the L.C.C. was considered by the B.C. on Wednesday. It was resolved that consent be given to the underground, but not to the overhead system of traction.

Southwark.—The Highways Committee of the L.C.C. has asked the Council's consent to the introduction of a Bill to construct a tramway from Southwark Street, *viâ* Stamford Street and York Road, to Westminster Bridge Road. The communication was referred to the Works Committee.

London.—The Wandsworth Borough Council has agreed to the electrical re-construction of the Brixton Hill and Streatham tramway, but declines to make a contribution to the cost of street widenings. The same course has been taken with regard to the proposed line from Clapham Common to East Hill. Woolwich Borough Council has agreed to the L.C.C. project for a tramway from Beresford Square to Bostal Wood, and will pay a third of the cost of widening the road and execute the necessary paving works. Deptford Borough Council has come to an agreement with the L.C.C. as to the proposed line from New Cross through Lewisham High Road.

Stretford.—The D.C. decided last week to make application to the Light Railway Commissioners for an order under the Act of 1896 authorising them to construct and work a light railway in the parishes of Stretford and Davyhulme.

Sydney (N.S.W.).—The *Daily Chronicle* says that as a result of the rapid growth of the electric tramway system, the Cabinet has decided to order another £100,000 worth of machinery.

Vienna.—The last horse car gave way to electric traction on Friday last, an amusing ceremony signalizing the event.

York.—The Tramways Sub-Committee met on June 23rd, and had under consideration two schemes submitted by Mr. Kincaid, chairman of the York Tramways Co., for the electrification of the tramways and the making of extensions to Acomb and Clifton. It was proposed to adopt the overhead trolley system; one scheme provided for the company generating the power themselves, and the other for its provision by the Corporation from their electric lighting station. The Sub-Committee recommended the Streets and Buildings Committee not to entertain either proposal.

Continued on page 23.

THE NEW ELECTRICITY WORKS OF THE MANCHESTER CORPORATION.

(Continued from Vol. 52, page 1092.)

The extensions which are now in progress, to the designs and specifications of Mr. G. F. Metzger, the City electrical engineer, are arranged with a view to their forming part of a homogeneous scheme of great magnitude, as may be gathered from the plan of the site which was published in our last issue. The decision to proceed with this work was arrived at by the Electricity Committee long before the plant laid out by Dr. Kennedy was ready for use, owing to the heavy demands for electrical energy formulated by the Lighting and Tramways Committees, it having been the intention of the Council to embark on a huge scheme of public lighting by electricity. As it turned out, the latter project was abandoned, and the traction load also fell far short of the value originally estimated, so that at present the plant already installed is capable of easily coping with the whole demand. There can be no doubt, however, that with such a magnificent industrial area to deal with as that of Manchester and the numerous neighbouring districts which take their supply from the Corporation, the output will very soon increase to an enormous amount, sufficient to tax the resources of the whole of the plant in place or in course of completion.

The first instalment of Mr. Metzger's scheme comprises generating plant of 12,000 H.P., but the buildings are designed to accommodate twice this amount. They are of steel framework, constructed, like the former, by Messrs. De Bergue & Co., Ltd., and filled in with brick by Messrs. C. H. Normanton & Son. The boiler house, which measures 139 ft. × 231 ft., with a height of 88 ft., is at right angles to the existing boiler house. Over the top of it there will be a bunker capable of storing 5,000 tons of coal; two electrically-driven conveyors will be provided to raise the coal from the hoppers under the railway sidings to the bunkers, and these will also remove the ashes from beneath the stoking floor to ash bunkers outside the boiler house.

The steaming plant will consist of 12 Babcock & Wilcox boilers of the largest size made, each having a heating surface of 5,700 sq. ft., and being capable of evaporating easily 20,000 lbs. of water per hour. Each boiler is composed of 20 sections of 13 tubes, these being 4 in. in diameter and 18 ft. long, and two steam and water drums 54 in. in diameter, joined at the rear end by a cross drum 20 in. in diameter. The boilers are provided with the same makers' chain grate stokers and superheaters, and with the usual fittings. The stokers will be driven by either electricity or steam at will. Space is provided in the boiler house for 24 boilers in all; they will be arranged in two rows down the sides, with a central bay between them, 20 ft. wide; behind each boiler will be an economiser of 240 tubes, and behind this again come the main flues, which run completely round the building, for the most part above the ground level. A third chimney is to be erected, 20 ft. in diameter inside, 250 ft. high, and lined to a height of 100 ft. with firebrick. As previously stated, part of the waste gases from the extension boilers will be carried away by the large chimney which is already built.

In addition to the boilers and their accessories, the pipework, coal-measuring gear and conveyors will be supplied by Messrs. Babcock & Wilcox, Ltd. The economisers will be made by Messrs. E. Green & Son, Ltd.

The pump room adjoins the boiler house, in the angle which it makes with the existing boiler house, and will contain four compound duplex steam pumps made by Messrs. Blake & Knowles; each pump will be capable of delivering 12,000 gallons per hour at boiler pressure, and will be so arranged that either side of the pump can be used alone. The pumps will normally draw from the hot-well, which will be situated in the pump room, but can also draw from the feed-water tanks. In this room there are two feed-water heaters of 600 sq. ft. heating surface each, made by Messrs. Holden & Brooke, and two Watson filters, through which the water passes on the way to the economisers. The piping is arranged in duplicate, with bye-passes.

Parallel with the boiler house there is to be an extensive range of workshops, including even a foundry, and a machine shop measuring 120 ft. by 40 ft., in which any part of the plant can be handled. Over these workshops are the feed water tanks, having a capacity of 500,000 gallons. Railway sidings will be provided, running alongside and round the end of the boiler house. Besides high-level tracks over the coal hoppers, low-level tracks will be laid down, running right through the engine room, and serving also to remove ashes to the canal bank.

The steam piping will consist of a ring main in the boiler house, with separate connections to each boiler for saturated and superheated steam. From this ring a single connection will be taken direct to each engine. The pipes will be of lap-welded steel, with wrought-iron flanges screwed on. A steel shaft 80 ft. high will be provided for exhaust to atmosphere.

The engine room measures 174 ft. × 115 ft., with a height of 54 ft. to the crane rails, and a clear height of 108 ft. to the apex of the roof, which will be provided with skylights and a louvred lantern. The main switchboard gallery will extend along the side of the engine room, and will be continuous with the existing gallery. Two 50-ton electric travelling cranes, by Messrs. Higginbottom and Mannock, will be provided.

The generating plant will consist of two 3,750-KW. sets, each comprising a 6,000 I.H.P. vertical triple-expansion engine running at 75 revolutions per minute, and a three-phase alternator, working at 6,500 volts, 50 cycles per second. The engines will be supplied by the Wallsend Slipway and Engineering Co., Ltd., of Newcastle-on-Tyne, and are larger than any other reciprocating engines installed in this country for electric power generation. They will have four cylinders and four cranks each, and will work with 190 lbs. pressure at the stop valve, with superheated steam. The valve gear will be of the Corliss type; the cylinders are 37 in., 59 in., and two of 72 in. diameter, with a stroke of 5 ft. The shaft is 31 in. in diameter in the fly-wheel, and 21 in. at the journals. The engine will stand 32 ft. in height above the floor level.

The generators will be supplied by the Electrical Co., Ltd., and will be of the revolving field type, with the poles mounted on the periphery of a fly-wheel weighing 160 tons, and 27 ft. in diameter. The armature winding will be of the usual type, and the field-poles will be provided with amortisseurs.

For excitation there will be two 200-KW. dynamos driven by induction motors, and generating at 200 volts. Exciting current will also be available from the auxiliary generators already installed.

The exhaust steam will be dealt with by two surface condensers, supplied by Messrs. Mather & Platt; these are of the usual tubular type, each having a working surface of 11,000 sq. ft., and being capable of dealing with 72,000 lbs. of steam per hour. The condensers are fixed in the basement, 20 ft. below the engine room level, with the air and circulating pumps, which are driven off the crossheads of the respective engines. The air pumps are in duplicate, and are to be used as wet and dry pumps. Oil separators of the Baker type are to be installed between the engines and the condensers.

The water for condensing will be cooled by means of six towers, each capable of cooling 90,000 lbs. of water per hour from 125° F. to 85° F. Three of these will be supplied by the Wheeler Condenser Co. and three by Mr. Arthur Koppel; they will be fitted with fan draught, and will be 52 ft. high, 15 ft. 8 in. × 16 ft. 3 in. in plan.

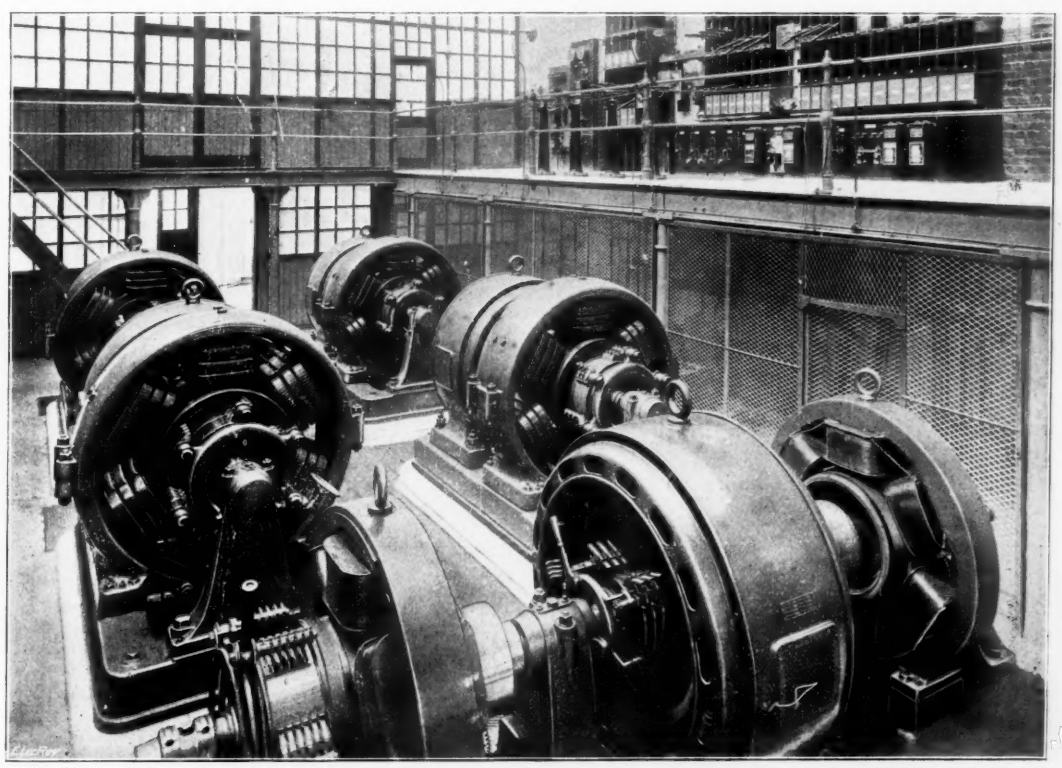
Besides the generating plant, there will be sub-station plant in the engine room, consisting of four 175-KW. synchronous motor-generator sets, and a 125-KW. induction-motor balancer.

The switchgear is being supplied by Messrs. Ferranti, Ltd., of Hollinwood, on their cellular system, and will fulfil practically the same functions as the existing boards, with the addition of switchgear to control the sub-station plant. The traction and lighting bus-bars will normally be kept separate, in conjunction, however, with the corresponding bars in the existing plant; they are not in duplicate in the new plant, as there is no doubt that the traction and lighting can both be supplied from the same bus-bars, if desired. We have pointed out on previous occasions that, where synchronous motor-generators are used in the sub-stations, the fluctuations of the traction load have no influence whatever on the lighting voltage, provided that the speed of the main generators remains constant; but apart from this, the

traction load will be so heavy that the fluctuations will be negligible.

The stage at present reached in the erection of the new buildings is as follows :—The steel framework of the walls has been erected, and is being filled in with brickwork ; two electric cranes are in place. The roof principals are being rivetted up on the floor level, and two of them will shortly be in position. The work on all the switchboards and sub-station plant is well advanced under temporary roofing. The cooling towers for both schemes are in course of erection.

We now pass on to the sub-station equipment, taking the newer ones first for convenience—*i.e.*, those erected as part of Mr. Metzger's scheme. The views given herewith show the interior of the sub-station at Sherbourne Street, and as the buildings are all much alike in design and equipment, they may be taken as representative of all the later sub-stations. Each station consists of one bay containing the machinery, with the switchgear on either side on raised platforms. The standard equipment consists of four 150-KW. motor-generators and one 100-KW. motor-balancer, all but the last mentioned being driven by synchronous motors. Provision is made for extensions with larger units, of 300 KW. each.



Interior of Sherbourne Street Sub-Station.

The illustration above shows the four motor-generators, each consisting of a three-phase motor, receiving current direct from Stuart Street at 6,500 volts, coupled to a six-pole dynamo giving 375 to 275 amperes at 400—550 volts, at 500 r.p.m., the generator being available either for lighting, as a shunt-wound machine, or traction, as compound wound. In the foreground is a balancer consisting of two dynamos, each rated at 255—230 amperes, 205—225 volts, driven by an induction motor at 480 r.p.m. It will be seen that the balancers can be started without difficulty from the alternating side, after which the other sets can be run up with direct current, without assistance from the distributing network, though the latter is available if required. The synchronous motors are excited either from the balancer at 200 volts, from the lighting bus-bars, or, as described hereafter, by a special arrangement of slip-rings and "chokers," each set can be made self-exciting. The latter method is adopted for all sets running on traction, thus making them independent of any faults on the lighting network. All the motor-generators were supplied by the Electrical Co., Ltd.

The switchboards are of Messrs. Ferranti's make, and are in two sets, the high-pressure boards on one side of the room, and the low-pressure on the other.

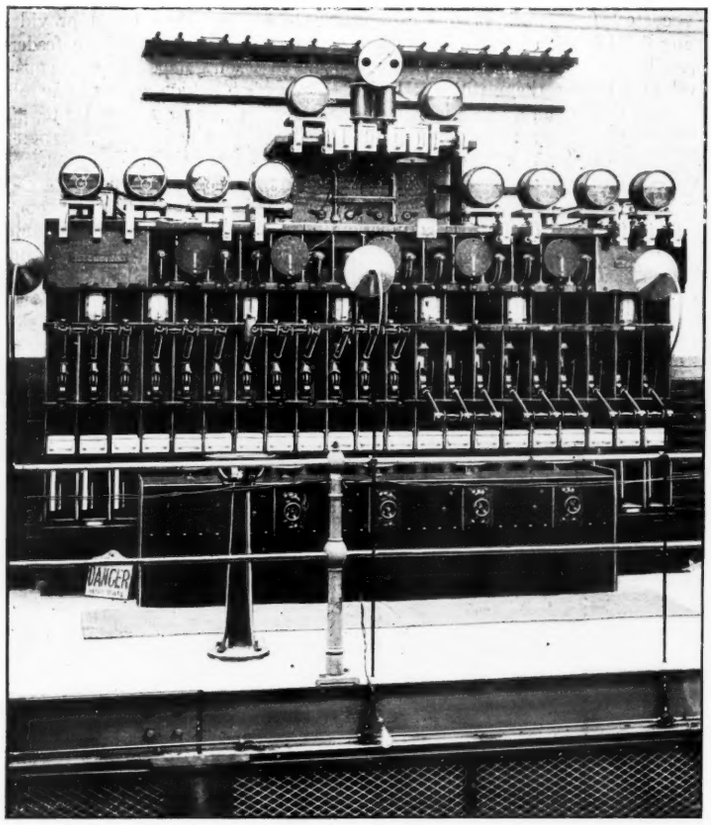
The high-pressure board provides for the control of the motors and the high-pressure feeders, both incoming and, in some cases, outgoing. Separate bus-bars are used for lighting and traction, which cannot be paralleled at the sub-station. Synchronising gear is provided for paralleling the synchronous motors with the bus-bars, a rotary synchroniser of Messrs. Everett, Edgcumbe's being used. Three voltmeters are connected between the conductors of each feeder and earth, and a fourth is joined across two of them. It is interesting to see the former all indicating the same mean voltage, showing equality in the insulation of the three cores.

The A.C. switchboard illustrated on p. 20, provides for two feeders—one lighting, the other traction—and the five motors. A two-way switch in connection with each of the latter connects it with either set of bus-bars, the position of the switch being shown by a pointer in front of the compartment containing the switch. An edgewise ammeter is inserted in circuit with one pole of each motor and feeder. Over the board is a rack prepared for the fitting of power factor indicators, and in front of the board are four regulating hand-wheels for use in paralleling. A standard carries a handwheel working a water rheostat for starting the induction motor, and a fifth handwheel on the front of the board controls the resistance in series with the rotor. Lightning arresters—or, rather, spark gaps—are fixed at either end of the board in connection with the feeders. The main fuses are of the Ferranti oil-break type.

The low-pressure board, on the opposite platform, is divided into two parts. That on the right in the view (p. 20), has eight panels for controlling the main generators, the + and — pole of each machine being side by side ; the regulating rheostats are controlled by hand-wheels on the front of the board, and over the main switches are change-over switches for coupling with either the lighting or the traction D.C. bus-bars, the former being placed above the latter. Four edgewise ammeters surmount the board ; and equaliser switches for cutting out the series winding when the machines are used for lighting, and coupling up to the equaliser bar when running on traction, are fixed below. All the lighting energy goes through a single watt-hour meter shown on the right of the generator board, and all the traction energy through a similar meter on the left. A paralleling

voltmeter is provided for the generators, with the necessary switches. Four panels are provided for the balancer switches, and over these are throw-over switches for putting either balancer on either side of the middle wire. Next to these, on the right, come eight panels controlling four lighting feeders. Station and recording voltmeters, a recording ammeter for the mid-wire, &c., are provided.

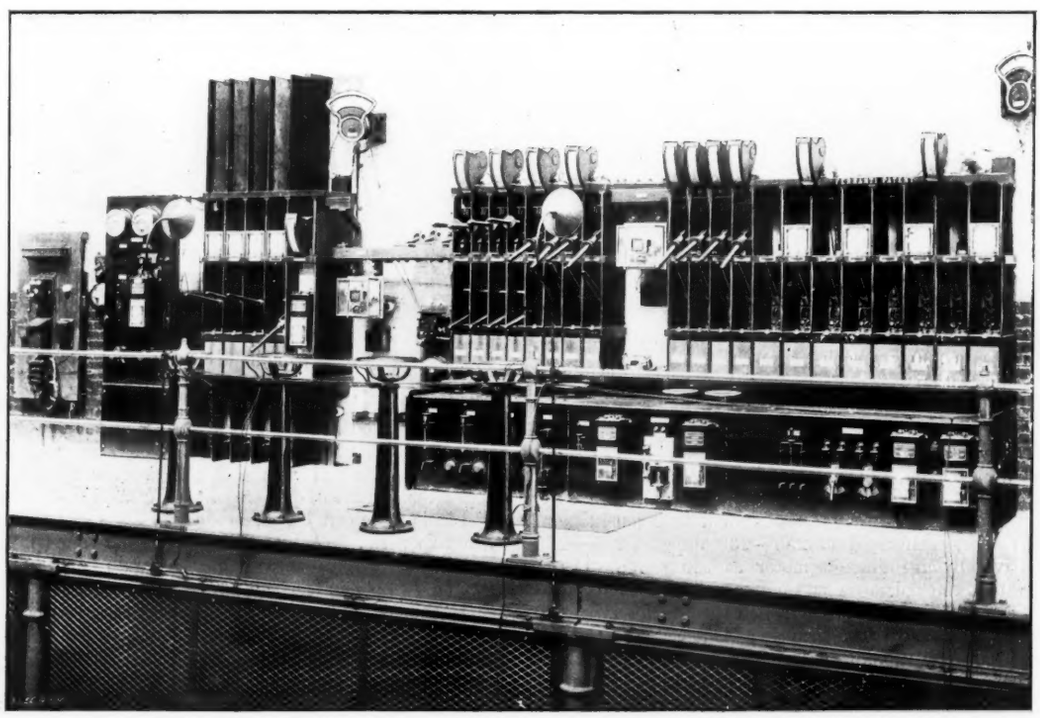
The traction feeder board is on the left hand; it controls four outgoing positive feeders to the trolley wires, with lightning arresters and kicking coils below, and circuit-breakers above. An edgewise ammeter and a recording ammeter, in series with the rail return, are fixed on the right of the feeder board. On the left of the latter is the Board of Trade switchboard, supplied, as well as the other recording instruments, by Messrs. Elliott Bros. Hand-wheels for controlling water rheostats, used in starting the machines from the D.C. side, are carried on standards on the front of the platform; these rheostats are installed, with the shunt regulating resistances, beneath the platforms.



ALTENATING CURRENT SWITCHBOARD IN SUB-STATION.

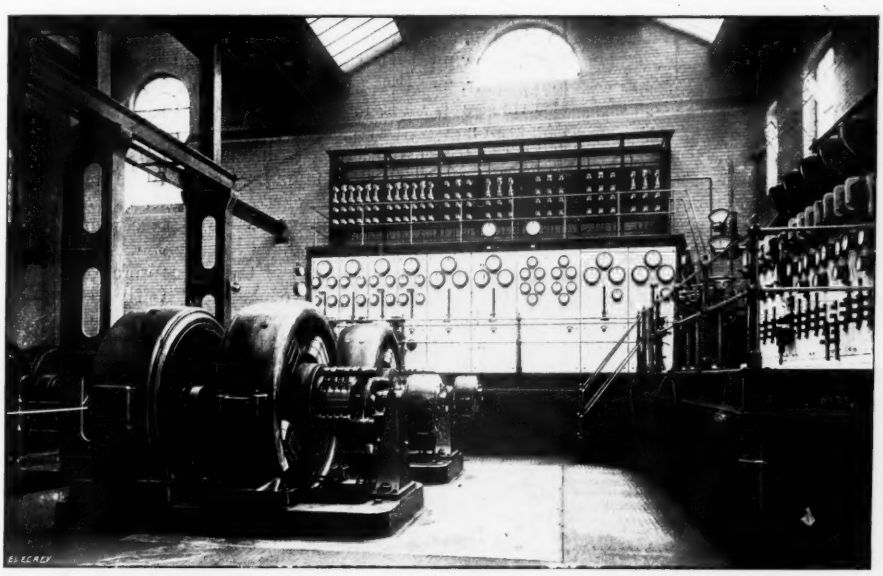
There are 10 such sub-stations as the one just described, all but two being equipped for both lighting and traction; the exceptions are for lighting only. They are situated in the following positions: — Newton Heath, Stuart Street, Harpurhey, Queen's Park, Cheetham Hill, Openshaw, Oldham Road, Sherbourne Street; and for lighting only, Whalley Range, Chorlton-cum-Hardy.

Of the 10 sub-stations erected in connection with the first installation—that of Dr. A. B. W. Kennedy—all but one (that at Didsbury) are equipped for lighting and traction, and are here represented by the views which we give of the Polygon sub-station. The whole of the plant and switch-gear in these stations was supplied by the Electrical Co., Ltd. The motor-generators are generally similar to those which we have already described, the generators being, however, of 220 KW. output, and being definitely allocated either to lighting, with shunt winding, or to traction, with compound winding. The traction sets generate at 500—550 volts, and the synchronous motors which drive them are excited from small dynamos carried on the



DIRECT CURRENT SWITCHBOARD, SHERBOURNE STREET SUB STATION.

extended shafts of the sets, or alternatively from the direct-current bus-bars. Two such sets are shown in the foreground of the view below, while the other two are seen in the distance in another bay. The lighting sets generate at 410 volts, for coupling across the outers of the three-wire system, and the dynamos are provided with slip rings after the style of double-current generators giving two-phase currents. The respective pairs of slip rings are coupled together through inductance coils, and from the middle points of the latter connections are taken to a third inductance; from the middle point of this coil a connection is taken to the middle wire of the three-wire system. The effect of this arrangement, as has been previously pointed out in the Electrical Review, is to make each generator practically self-balancing, the out-of-balance current being returned through the inductance coils in question. In addition to this, however, there is a separate balancing set, consisting of two 50-kw. dynamos driven by an induction motor, as in the later stations. Either or both of these dynamos can be used on either side of the system; they can also be run up from the high-pressure side, thus providing direct current to start the other machines. The synchronous motors are excited from the terminals of the generators, or from the lighting bus-bars.

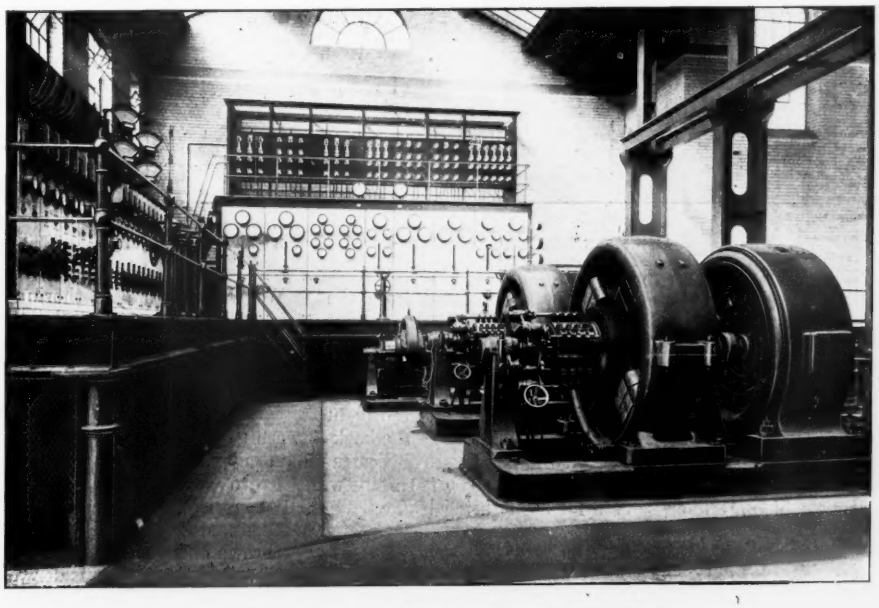


Interior of Polygon Sub-station: Traction Side.

Each sub-station is provided with separate high and low pressure switchboards for lighting and traction; at the Polygon the high pressure boards are at opposite ends of the station, and closely resemble the switchboards at Stuart Street, as will be seen from the accompanying views. The traction H.P. board consists of two feeder panels, one feeder charging panel, one testing panel fitted with voltmeters showing the pressure between each phase and earth, one interconnector panel for coupling with the lighting H.P. board, and four motor panels. Over the switchboard proper is a selector board for connecting any feeder or generator with either of two sets of bus-bars, as at Stuart Street station. The low pressure traction board comprises four generator panels, five feeder panels and one earth return panel, with Elliott recording instruments. The lighting H.P. board is precisely similar to the traction board, except that it controls only two synchronous motors and one induction motor. The low pressure lighting board consists of two generator panels, two balancer panels, with double-pole change-over switches, one mid-wire panel, and six feeder panels. The mid-wire panel carries recording voltmeters for the positive and negative sides, and a recording ammeter to show the earth current, with an automatic switch which inserts a resistance in the earth wire at 50 amperes, and changes the shunt of the ammeter; the earth connection, however, is not at present made in the sub-stations. The feeder panels are fitted with + and − switches and circuit-breakers, and are separated by slate slabs. It is interesting to mention in this connection that the original five-wire system laid down by Dr. Hopkinson is still in use in the central parts of the city.

Water rheostats are provided under the switchboard platforms for starting up the machines, and there is a starting panel for the traction sets on the lighting switchboard.

There is space available in the second bay of this sub-station for four additional motor-generators. The stations are all well-lighted and spacious, with an overhead crane in each bay, and are well provided with accommodation and conveniences for the staff.

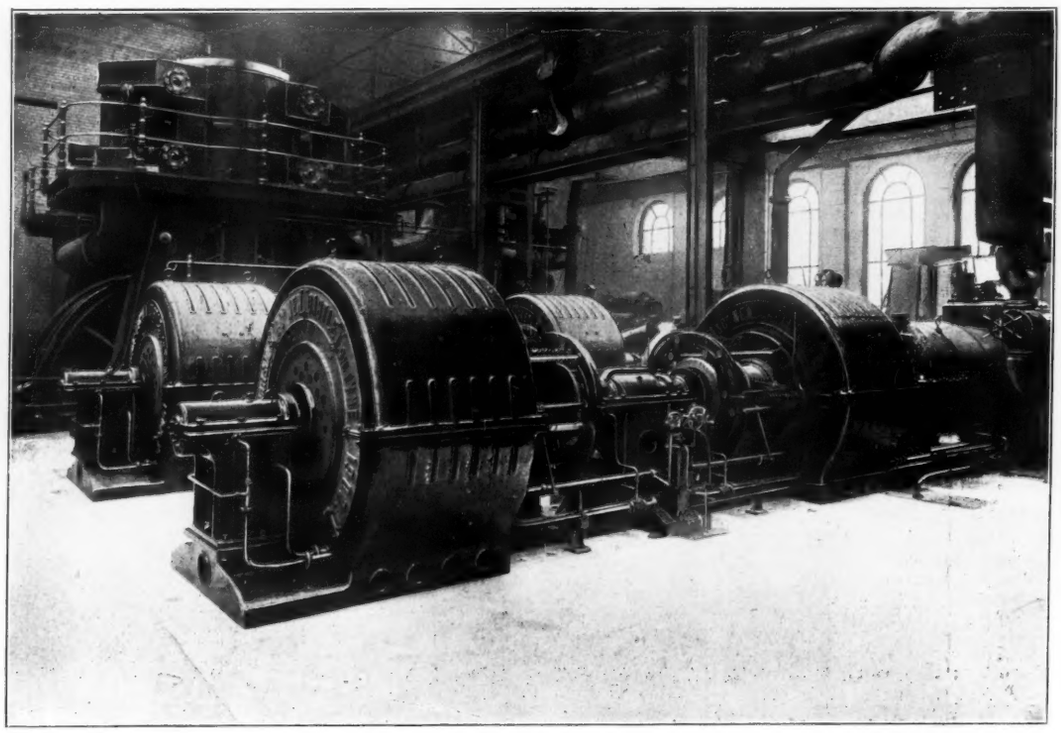


Interior of Polygon Sub-station Lighting Side.

The ten sub-stations provided under Dr. Kennedy's scheme are situated as follows:—Bennett Street, Levenshulme and Polygon, each equipped with four traction sets and two lighting sets; Moss Side, four traction sets, one lighting set; Rusholme, Denton, Heaton Norris, Withington, each with two traction sets and one lighting set; Fallowfield, with one traction and one lighting set; and Didsbury, with one

lighting set only. Every sub-station has also a balancing set. The cables connecting the sub-stations with the power station at Stuart Street, and with one another, were supplied and laid by Messrs. W. T. Glover & Co., Ltd., to the extent of no less than 170 miles.

We conclude this instalment of our article with some particulars of the turbo-generators which have recently been installed at the Dickinson Street generating station, and which are illustrated below. These two splendid machines were supplied by Messrs. C. A. Parsons & Co., of Newcastle-upon-Tyne; each consists of two 900-KW. dynamos coupled to a Parsons steam turbine, and running at 1,040 r.p.m. The two dynamos of each set are treated as one machine, giving 400 volts, and are used for lighting only. Each set is provided with its own jet condenser, the condensing water being obtained from the canal. The arrangement of this plant is interesting. The hot water is discharged from the condenser by means of a centrifugal pump, which is placed on the discharge side, the injection water being forced into the condenser by atmospheric pressure.



DICKINSON STREET GENERATING STATION: PARSONS TURBO-DYNAMOS, 1,800-KW. EACH.

Priming water to start the pumps is obtained from the main water-supply pipe, which runs through the engine room at a sufficient height. Should the water flood the air pump, which is intended to remove the air only, an automatic cut-out stops the pumps, and the engines exhaust to atmosphere. These two generating sets have replaced plant of an obsolete type of only half their capacity. In the background behind them may be seen two fine Musgrave-Siemens and Musgrave-E.C.C. steam dynamos, each of 1,500-KW. output, which are likewise used for the lighting load only.

(To be concluded.)

THE ROYAL SOCIETY CONVERSAZIONE.

THE exhibits at the Royal Society Conversazione on 19th inst. were, for the most part, the same as those exhibited at the previous conversazione on May 15th (ELECTRICAL REVIEW, Vol. 52, p. 895). There were, however, some new exhibits of very considerable interest.

Prof. E. Rutherford, F.R.S., and Mr. F. Soddy, exhibited their apparatus for showing the existence and properties of the "emanation" from thorium and radium. A current of air was passed over powdered thorium oxide contained in a bulb in the centre of a glass tube. The air carrying the emanation passed through a plug of cotton wool, then through sulphuric acid, and finally into the bottle of a gold leaf electrometer. The leaves of the electrometer, which had been previously diverged by a small charge of electricity, immediately collapsed when the emanation reached them, showing that this emanation had the property of ionising air, and thus making it incapable of supporting an electric strain. The fact that the properties of the emanation are unaffected by passing it through the strongest acids has led to the conclusion that the emanation is an inert gas belonging to the argon family. Though the gas is not affected by the strongest chemical reagents, it can be liquefied by passing it through a spiral tube immersed in liquefied air. This remarkable experiment was shown by means of the apparatus of the Canadian professors. The view of these *savants*, as explained recently before the Physical Society, is that the emanation is a product of the disintegration of the atom of the radio-active substance. When the atom of thorium breaks down, it throws off pieces whose mass is about equal to that of the atom of hydrogen, and which have a positive charge of electricity. The first product of disintegration is Thorium X. Thorium X then disintegrates into the "emanation," and the emanation in its turn disintegrates into "excited activity." All these products or residues of the disintegration of the atom throw off positively charged pieces of the size of the hydrogen atom till the last stage of disintegration is reached, when negative electrons of a mass which is only one-thousandth part of the mass of the atom of hydrogen are thrown off. The energy of the particles radiated from the disintegrating atoms is derived from the intrinsic energy of the atom which is liberated when the particles are thrown off. This is the Canadian theory worked out by Prof. Rutherford and his collaborators. The energy which enables radium to emit a constant flow of heat is, according to this theory, derived from the intrinsic energy of the atom—an energy which only makes itself manifest when the atom breaks up.

Mr. Henry Crookes, F.C.S., had a series of interesting exhibits, showing the effect of the radiation from radium on bacteria. Various cultures of bacteria were exposed to the action of 10 milligrammes of bromide of radium through a mica screen, at about 1 in. distance from the surface of the

plate. The mica screen stops the massive positive electrons, but allows the light negative electrons and the highly penetrative X rays to pass through to the bacteria cultures. After having been thus exposed to the radium for about 24 hours, the cultures were incubated for 24 or more hours. In every case it was found the microbes were killed where they had been exposed to the radium, so that on incubation a bare space free from bacterial growth was left on the plate opposite the point where the radium had been placed. None of the microbes experimented with belonged to the malignant class which give rise to such dangerous diseases as typhoid and cholera, but there is no reason to suppose that such microbes will be proof against the destructive action of the radium rays. These experiments of Mr. Crookes promise to lead to most important developments in medical treatment.

Prof. E. Wilson exhibited the Cooper-Hewitt mercury vapour lamp. The light, though almost entirely lacking in red rays, and, therefore, producing a considerable distortion in colour values, is for very many purposes superior to the ordinary electric light. One of the greatest fields of application of the lamp is for all sorts of photographic purposes. The inefficiency of the light is about ½ watt per spherical candle-power, and, under favourable circumstances, as low as ·3 watt per candle-power, the efficiency being about seven times that of the ordinary electric glow lamp.

Dr. S. R. Milner exhibited an automatic mercury vacuum pump. The instrument is a Töpler pump of the shortened type with a fixed, instead of a movable, reservoir. The reservoir is alternately connected to the atmosphere and to a water vacuum pump by a three-way tap, the turning of which is controlled by electric contacts made by the mercury of the pump. It is necessary in pumps of this type that the air from the pump bulb should be first expelled into a highly exhausted "auxiliary" chamber, this being periodically emptied into a larger vessel evacuated by the water pump. In the pump this latter operation is caused to take place automatically whenever a certain limiting amount of air has been accumulated in the auxiliary chamber. A special feature of the instrument is the form of the pump head, which prevents the possibility of any air trapped in the capillary exit tube from the pump bulb being ever dragged back into the bulb on the downward stroke.

Dr. Mackenzie Davidson exhibited the latest form of his stereoscopic fluoroscope. In this instrument there are two focus tubes which are excited alternately. The mercury break which controls the two induction coils of the lamps is a **T** mounted on the inclined axis of an electromotor. Two makes and breaks are made by the arms of the **T** at each revolution. The revolving shutter placed in front of the eyes at the end of the dark box is driven by a flexible shaft from the axis of the electromotor which drives the break, and thus synchronism of the lamps and the shutter is secured.

ELECTRIC TRACTION NOTES.

(*Continued from page* 17.)

S.E. and C. Railway.—The Court of Referees (presided over by Mr. Parker Smith) on June 26th adjudicated on a petition of the Corporation of the City of London to be heard against the Bill of the South-Eastern and London, Chatham and Dover Railway Co., one of the objects of which is to provide for the ultimate electrification of the company's line. Mr. Pollock, the City Remembrancer, appeared for the Corporation to show cause why they should be allowed a *locus standi*. He said (according to the *Daily News*) that when the railway was electrified—it might be six years hence—electric traction, which was now only in its infancy, might have developed so that large engines might be in use, also strong electric currents, which might cause great injury by electrolysis to service works for which the Corporation was responsible. Damage might be done to gas and water pipes and mains, and to other service works. Mr. Clode, who appeared for the promoters, opposed the *locus* of the City, and said there were no pipes or wires in the neighbourhood of the railway which could suffer from electrolysis. The *locus* was disallowed.

Wirral Railway.—It is stated that the electrification of this railway has been decided upon, and that the work is to be carried out by the British Westinghouse Co., who recently completed the electrification of the Mersey Railway. The distance from Seacombe to Hoylake is, in round figures, seven miles.

Whitefield.—The U.D.C. has asked the B. of T. to prolong the time for the completion of the electric tramways to August 6th, 1905.

TELEGRAPH AND TELEPHONE NOTES.

Argentine Republic.—The Argentine Government has voted a sum of about £3,000 for the extension of the telegraph system in the territory of the Pampas Central, and the construction of a line between General Acha and Santa Rosa de Toay.

International Telegraphic Conference. — Reuter's agent at Buenos Aires telegraphed on June 28th:—"The newspapers here criticise severely the reported proposal of the Argentine delegate to the International Telegraphic Conference in London for the application of a surtax of 5 centimes per word on Press and full-rate telegrams from France."

The submarine telegraph companies gave an entertainment to the members of the Conference on Monday night in the gardens of the Royal Botanic Society at Regent's Park. The guests, about 700 in number, were received by Sir John and Lady Denison-Pender. Nine companies were represented. The gardens were illuminated with thousands of variegated lamps. The band of the Irish Guards performed selections of music from 9 to 11.30, while a variety entertainment was held in the large conservatory. Dancing took place in the club rooms, and supper was served in tents in the grounds.

Portsmouth Telephones.—The inauguration of the municipal telephone system took place in the Grand Jury Chamber at the Town Hall on Friday evening. The district covered by the municipal exchange embraces an area of 100 square miles, and includes Gosport, Lee-on-the-Solent, Fareham, Titchfield, Cosham, Emsworth, and Hayling Island. The cost of the system, providing for 1,240 subscribers, was £26,360; and it has been found necessary, in consequence of the continuous applications for connections, to apply for a further loan of £12,000. The Municipal Telephone Committee have acted under the advice of Mr. A. R. Bennett, and Mr. W. Gardner is the general manager. Mr. Bennett having, with the assistance of maps, explained the system, the Mayor, in declaring the exchange open, said he thought the municipal exchange connected the subscribers far more rapidly than did the National system. Rapidity and proper attention were the essence of the whole thing in a successful exchange. He paid a high compliment to Mr. W. T. Dittman, chairman of the Committee, for the energy and ability which he had displayed. The Mayor gave a banquet in honour of the King's birthday, and to commemorate the opening of the exchange. In the course of the evening Mr. Dittman announced the receipt of a telephone message from the chairman of the Glasgow Telephone Committee, expressing a hope that the Portsmouth undertaking would prove as great a success as that of Glasgow. Mr. Alfred C. Devey, engineering representative of the British Insulated and Helsby Cables Co., the contractors, asked the Mayor to accept a silver rose bowl as a souvenir of the opening of the telephones. The Mayor, in reply, suggested that everyone should be able to have a telephone for a "fiver," and that the charge should be reduced from £5 17s. 6d. to that amount.

Telegraphic Interruptions and Repairs:—

CABLES.	INTERRUPTED.	REPAIRED.
Latakia-Cyprus	June 20, 1899 ..	..
Trinidad-Demerara No. 1	Aug. 27, 1901 ..	..
Trinidad-Demerara No. 2	June 9, 1903 ..	June 30
Dominica-Martinique	May 8, 1902 ..	..
St. Lucia-Martinique	May 8, 1902 ..	..
Guadeloupe-Martinique	May 9, 1902 ..	..
Martinique-Puerto Plata	July 10, 1902 ..	..
Cayenne-Pinheiro	Aug. 13, 1902 ..	..
St. Lucia-St. Vincent	Sept. 19, 1902 ..	..
Reissa-Issa	Oct. 22, 1902 ..	..
Reissa-Yemani	Oct. 23, 1902 ..	..
Paramaribo-Cayenne	Feb. 27, 1903 ..	..
New York-Haiti	April 13, 1903 ..	..
Assab-Massowah	June 1, 1903 ..	June 30
LANDLINES.		
Dagua-Buenaventura..	June 22, 1903 ..	June 25

Telegraphs in Uganda.—Reuter's agent at Mengo writes:—"The extension of the telegraph system has been pushed on rapidly during the last six months, and now the line is open to Butiaba, on the shore of the Albert Nyanza. A branch line has been built to a place called Masinde, in Unyoro, a distance of some 50 miles from the main line. On all these extensions there is no extra charge; thus the mileage open for traffic now in Uganda is as follows:—Mobasa to Port Florence, on the Victoria Lake, 584 miles; Port Florence to Kampala and Mengo (temporary line), 200 miles; Kampala to Entebbe, 25 miles; Entebbe to Albert Nyanza, 175 miles; Hoima, Unyoro, to Masinde, 50 miles; total, 1,034 miles. The charge over the whole of this distance is 2d. a word, with a *minimum* of 1s. 4d. for a message of eight words. There is also a system of telephones along the whole distance, so that traders and travellers may use the line when necessary at the charge of 1s. 4d. per conversation. These telegraph lines are called 'temporary,' but, as the poles are constructed of bark cloth tree (a species of fig tree), and as these have extraordinary powers of germination, all the telegraph poles are now living trees, and should be almost equal in point of duration to iron poles, for the fig tree is long-lived."—*Times*

Municipal Telephones.—Mr. Stuart Wortley having asked to what municipalities licences have been granted under the Telephone Act of 1899, Mr. Austen Chamberlain (say the *Times*) supplies the following information:—

Licensee.	Date of licence.	Date of expiration of licence.
Glasgow Corporation	March 1 and 6, 1900	December 31, 1913
Tunbridge Wells Corporation	April 30, 1900	(see note)
Belfast Corporation	February 28, 1901	December 31, 1911
Brighton Corporation ..	April 30, 1901	April 30, 1926
Chard Corporation	December 13, 1901	June 24, 1922
Grantham Corporation ..	September 18, 1900	December 31, 1911
Huddersfield Corporation ..	February 22, 1901	February 28, 1926
Portsmouth Corporation ..	September 21, 1901	June 31, 1926
Hull Corporation	August 8, 1904	December 31, 1911
Swansea Corporation	September 27, 1902	December 31, 1920
West Hartlepool Corporation	September 30, 1902	September 30, 1927
Oldham Corporation	December 31, 1902	December 31, 1920
Scarborough Corporation ..	December 31, 1902	December 31, 1911

Note.—The system of the Tunbridge Wells Corporation was transferred by consent to the National Telephone Co. in November, 1902.

Wireless Telegraphy.—The *Central News* Rome correspondent says that the construction of Marconi wireless telegraphy installations for connecting Bari, in Italy, and Antivari, in Montenegro, will be commenced this month, the cost being defrayed entirely by the Italian Government. The tariff for messages has been fixed at 1 fr. for 20 words.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdare.—July 11th. The U.D.C. wants tenders for the installation of fire call bells. Particulars at the Surveyor's Office, Town Hall.

Bath.—July 17th. Jet condensing plant, feed pump, pipe work, &c., for electricity supply extensions. See "Official Notices" to-day.

Batley.—July 3rd. Tramway panels and Highfield booster for the electricity works. See "Official Notices" June 19th.

Derby.—July 13th. Battery, balancers and boosters, switchboards. See "Official Notices" to-day.

France.—July 7th. The French Ministry of the Colonies is inviting tenders until July 7th for the supply of 100 tons of annealed and galvanised iron telegraph wire for Indo-China. Particulars may be obtained from, and tenders are to be sent to, Le Ministere des Colonies, 4 bis, Rue Jean Nicot, Paris.

Guadeloupe.—August 29th. Tenders are being invited until August 29th next by the municipal authorities of Point à Pitre (Guadeloupe) for the concession for the public and private electric lighting of the town.

Hammersmith.—July 15th. Forty alternating current arc lamps, &c. See "Official Notices" June 26th.

Hungary.—August 31st. Tenders are being invited until August 31st next by the municipal authorities of Beszterczebanya (Neusohl) for the establishment in the town of a central electricity generating station of a capacity of 500 H.P.

Ipswich.—July 14th. Electricity meters. See "Official Notices" June 26th.

Launceston (Tasmania).—September 28th. 500 or more electric meters. See "Official Notices" June 12th.

Leek.—July 9th. Switchboard, balancing transformer and motor-generators, battery, crane. See "Official Notices" June 19th.

Middlesbrough.—July 4th. Underground mains, road work, &c. See "Official Notices" June 19th.

New South Wales.—September 12th. Tenders are being invited by the Railway Commissioners for New South Wales, for an additional generating set of 1,500 KW. for their tramway power station.

Norwich.—July 8th. Cables, meters, accessories, pump and motor. See "Official Notices" June 26th.

Pietermaritzburg.—July 6th. Cables, feeder and junction boxes, cable terminals and telephones for electric tramways. See "Official Notices" June 19th.

Pietermaritzburg.—July 29th. Six each single-deck bogie and double-deck single-truck cars for the Corporation. See "Official Notices" to-day.

Poplar.—July 8th. Arc lamp carbons. See "Official Notices" June 26th.

Portugal.—October 21st. Tenders are being invited until October 21st by the Portuguese Ministry of the Colonies in Lisbon for the concession for the electric lighting of the town of Macao in the Portuguese Colonies.

St. Pancras.—July 8th. Wiring the Godlington Buildings, Gt. College Street, for the Borough Council; also supply of cable to Electricity Department. See two "Official Notices" June 26th.

St. Pancras.—July 14th. 350,000 carbons (12 months' supply). See Official Notices" June 19th.

St. Pancras.—July 14th. Electric jenny and crab. See "Official Notices" June 26th.

Saltburn.—Storage battery for the Cleveland Trust, Ltd. See "Official Notices" June 19th.

Servia.—July 13th. The municipal authorities of Nisch are inviting tenders until July 13th for the establishment of a central electric lighting station in the town.

Spain.—July 10th. Tenders are being invited until July 10th by the Spanish Post and Telegraph authorities, for the supply and laying of a submarine telegraph cable between the Spanish possession of Fernando Po and the German Colony of Kamerun. Tenders are to be sent to La Direccion, General de Correos y Telegrafos, Carretas, 10, Madrid, whence particulars may be obtained.

Stepney.—July 21st. Pipe work, water softening plant, and storage tanks, for the electricity works. See "Official Notices" June 26th.

West Ham.—July 14th. High-tension feeders and other cables. See "Official Notices" June 19th.

Weymouth and Melcombe Regis.—July 19th. Boilers, engines and dynamos, and various other plant for electric lighting. See "Official Notices" June 26th.

CLOSED.

Barnsley.—The Corporation Electricity Committee has accepted the tender of Messrs. Ferranti, Ltd., for extensions to the switchgear at the E.L. works at £375.

Derby.—The tenders for the construction of the permanent way and the provision of electrical equipment and cars were considered by the Tramways Committee, and the Corporation has this week accepted that of Messrs. J. G. White & Co., of London, for £87,627. There were 72 tenders for all or various portions of the work, the five nearest to the accepted one being for the following amounts:—£95,795, £98,933, £93,217, £98,923 and £103,703. The total length of the six routes first to be proceeded with is 6 miles 3 furlongs 6 chains. The length authorised by the Corporation Act of 1901, is 17 miles 7 furlongs 3·15 chains.

Faversham.—The T.C. has accepted the tender of the Anchor Cable Co. for electric cables.

France.—The French Ministry of Posts and Telegraphs has placed contracts with M. Grammont, of Pont-de-Cheruy (Isère), and La Compagnie Française des Metaux, Paris, for a large quantity of copper wire at from 1,920 to 1,925 fr. per ton.

Heckmondwike.—The U.D.C. has accepted the tender of Messrs. Henley's Co. for extensions of the E.L. mains.

Ilkeston.—The Corporation has accepted the tender of the British Westinghouse Co., for the supply of four additional tramcars with Milnes bodies, providing two are delivered before August 1st.

Kettering.—The U.D.C. on June 24th accepted the following tenders in connection with the new electricity works:—Messrs. Parker, Ltd., Wolverhampton, for engines, dynamos and crane, £4,252; Messrs E. Danks & Co, for boilers, at £2,382 10s.; the Electrical Power Storage Co., for storage battery, at £1,049; Messrs. Cox-Walkers, for switchboard and boosters, at £2,183; the Gilbert Co., for arc lamps, at £262; Messrs. W. T. Glover & Co., Ltd., for mains and arc lamp-posts, at £7,694 7s. 11d.; Messrs. Babcock & Wilcox, for pipework, at £2,633.

Launceston, Tasmania.—We understand that the contract for the re-construction of the electric light and power transmission plant for Launceston, Tasmania, has been placed with Messrs. Witting, Eborall & Co., Ltd., of Temple Bar House, E.C. This contract comprises the supply of four Francis type turbines of 445 B.H.P. each, these turbines being direct coupled to 300 KW. three-phase generators, giving a terminal pressure of 5,000 volts. Also high and low-tension switchboards in generating station and sub-station, together with separately driven exciters, motors, and material for the overhead transmission line. The

plant previously in use consisted of 100-kw. single-phase alternators giving 2,000 volts. The re-construction of the present plant is being carried out by Messrs. Witting, Eborall & Co., Ltd., to the specification of Mr. William Corin, the Launceston City Electrical Engineer. We understand that the contract for the transformers for this installation has been placed with the Burnand Transformer Co, Ltd., of Salford, for 93 machines.

Leicester.—The Corporation Tramways Committee has divided the contract for the supply of new tramcars between Messrs. Dick, Kerr & Co., Preston, and the Brush Co., of Loughborough. The price is about £500 per car.

Stoke-on-Trent.—The T.C. on Friday accepted the tender of Mr. T. Godwin, of Hanley, for the erection of the electric light station and destructor works at £5,873.

Swansea.—Messrs. Mills, English & Co. have secured the contract for the electric lighting equipment for the Swansea Grammar and Technical Schools, at £611.

Yoker.—The Brandon Bridge Co., Ltd., Motherwell, has secured the contract for the girder and roofing work of the Clyde Valley Electric Power Co.'s extensive works at Yoker.

FORTHCOMING EVENTS.

Monday, July 6th.—At 11.45 a.m. At Earl's Court. Opening of the Fire Prevention Congress by the Lord Mayor.

Wednesday, July 8th (also 9th and 10th).—Annual Conference of the Municipal Tramways Association at Glasgow. (See "Notes" columns).

Wednesday and Thursday, July 8th and 9th.—Fire Congress at Caxton Hall, Westminster. "Electrical Safeguards and Fire Alarms" Section. Papers as follows:—

"Safety and Control Arrangements for Fire Alarm Systems," by Alex. Siemens.
"The Necessity of Automatic Fire Alarm Systems," by G. H. Oatway.
"Electric Wiring and Electric Risks," by Ed. C. de Segundo.
"Electrical Risks in Theatres," by Hip. Cazier, Criel.
"Necessary Practical Safeguards against Lightning," by Alfred Hands.

Wednesday, July 15th, and three following days.—Convention of the Municipal Electrical Association at Sunderland, &c.

ADDENDA TO ELECTRIC TRAMWAYS LIST.

Rothesay.—20 bogie motor-cars, Dick-Kerr and Brush motors. Add 1 Diesel oil engine and Dick-Kerr dynamo. Total capacity of plant, 400 kw.

Sheerness.—S. and District Electric Power and Traction Co., Ltd. Opened April, 1903. Manager, W. I. Cutbush. Electrical engineer, J. B. Rumford. 2¼ m. single, ¼ m. double track. Rails, 94 lbs. per yd. Side poles, flex. suspension. Brush motors. 3 B. & W., 3 Browett-Lindley-Brush sets, 360 kw. Mains, Callender solid. Lighting and traction station.

Stockport.—Track, 3½ m. double, 3 m. single. 30 motor-cars. Add 1 B. & W. Total capacity of plant, 600 kw. Annual car mileage, 451·24; passengers carried, 2,737,261.

Electricity Works.

Leith.—Extens. in progress.—2 Lanc., 2 Bellis-Silvertown, 350 kw. each. Max. load, 725 kw Total capital exp., £82,080 Pr. ltg., 59,637, inc. motors; lamps added, 24,520. Pub. ltg., 265 arc. Motors, 162 = 889 h.p. Units sold, 1,232,496. Price obtained, pr. ltg., 2·68d.; pub. ltg., £20 per arc lamp p.a. = 1·34d. per unit, inc. all charges. Works costs, ·753d.

Ryde and St. Helens.—Capacity of battery, 800 ampere-hours at normal discharge rate.

NOTES.

The Robertson Electric Lamp Works.—On Friday last week the opening of the extensions to these works was celebrated in due form in the presence of a large number of guests; the Mayor of Hammersmith took the leading part in the ceremony, thus formally recognising the importance to the borough of the industry which has been established within its borders by the General Electric Co., Ltd.

Prior to the actual opening ceremony, the guests were conducted over the whole of the works, which were in full operation, and the various processes in the manufacture of the "Robertson" lamp were explained to them; the inspection constituted an entertainment of unusual interest, while a neat brochure presented to each of the guests gave a brief account of the process of manufacture, and of the works of the Incandescent Electric Lamp Co., Ltd. The latter are said to be the largest of their kind in the kingdom, and have an output of over 3,000,000 per annum. The employés number 550, and will soon reach 700, while the company pays in wages over £20,000 per annum. In his address the Mayor referred to the fact that the company is the best customer of the borough electricity works, consuming over 150,000 units annually, in addition to the electricity generated by its own plant.

Mr. C. J. Robertson and Mr. C. Wilson, joint managers of the works, took part in the proceedings; Mr. G. Byng, chairman of the General Electric Co., and one of the founders of the works in 1893, was unable to attend, but sent an address, which we reproduce in another column.

The guests were entertained with light refreshments, and music provided by the Blue Hungarian Band; afterwards they witnessed an interesting turn-out and life-saving display, carried out by the works fire brigade in excellent style.

The Institution of Mechanical Engineers.—The summer meeting is to be held at Leeds, from Tuesday, July 28th, to Friday 31st. The following papers have been arranged for:—

"Economy of Fuel in Electric Generating Stations," by Mr. Henry McLaren.
"The Diesel Engine," by Mr. H. Ade Clark.
"The De Laval Steam Turbine," by Mr. Arthur Greenwood.
"Roofing Existing Shops while Work is Proceeding," by Mr. R. H. Fowler.
"A New Form of Friction Clutch," by Prof. H. S. Hele-Shaw, LL.D., F.R.S.

A full list of visits has been arranged, including the electric lighting and tramway stations, and numerous engineering factories

Sweet are the Uses of Advertisement.—We cull the following from the *Evening Standard* of Wednesday last:—

"The successful appeal of a contemporary against the magisterial conviction for having published an illegal betting advertisement, will be accepted as being the more equitable of the two rulings. The editorial chair is beset with so many difficulties that it would not be fair to add the responsibility for the intention with which every paid notice may be inserted. The most innocent announcement might be a cloak for the most fraudulent scheme; but it is not the duty of an editor to make exhaustive inquiries before putting it into his paper. If any advertisement contained matter which was in itself an infringement of the law, there would be some grounds for an action, but when there is no suggestion of a desire to commit a misdemeanour, and there is no proof of any irregularity having arisen from its publication, a prosecution can only be considered arbitrary even if the advertisement be that of a firm whose former transactions have brought them under the suspicion of the authorities."

The writer must surely have had in mind the strictures recently made by us and some of our technical contemporaries on a certain advertisement which appeared on several occasions lately in the business pages of the *Standard!*

Mersey Railway Engines and Cars.—Eighteen locomotives, 96 four-wheeled carriages and a gas plant and sundries, used until quite recently in the working of the Mersey Railway through the Mersey Tunnel, were catalogued for sale by auction, and were to have been sold on Friday last at Birkenhead. The stock was announced by the auctioneer, Mr. G. N. Dixon (Liverpool), to be in excellent condition, and an engine which originally cost £2,500, was first offered. Only one bid, of £250, was made, and the "lot" was withdrawn. A carriage was next offered, and was ultimately sold for £59. No other lots of the rolling stock were offered. The gas plant which had been producing 40,000 cub. ft. per week was submitted, but failed to elicit a bid. The sale then terminated. It is understood that some of the engines have since been sold by private treaty. The engines were built by Beyer, Peacock & Co., and Kitson & Co., and have cylinders 19½ and 21 in. in diameter with a stroke of 26 in. They have been displaced by the electrification of the Mersey Railway.

Society of Arts' Conversazione.—On Tuesday evening last the annual conversazione of the Society of Arts was held in the Gardens of the Royal Botanic Society, Regent's Park; the guests were received by the chairman, Sir W. H. Preece, and other members of the Council, and a very large number of visitors were present. The gardens and conservatory were illuminated with coloured lamps, and with the Kitson incandescent oil light—which it must be confessed was neither silent nor free from odour; elaborate displays of roses, by Messrs. Paul & Son, and of other flowers and pigmy trees by Messrs. Barr & Sons, evoked general admiration; the string band of the Scots Guards and the band of the Royal Engineers provided musical entertainment of excellent quality, and the weather was all that could be desired. Consequently this popular function passed off with all its usual *éclat*.

The Tramways Convention at Glasgow.—The official programme has been issued in connection with the annual conference of the Municipal Tramways Association of Great Britain, which takes place in the City Chambers, Glasgow, on July 8th, 9th and 10th. Mr. John Young, manager of the Glasgow Corporation Tramways, the first president of the Association, presides over the Conference, at which the following papers are to be read:—"Standardisation of Tramway Accounts," by Mr. J. Dalrymple, accountant to the Glasgow Corporation Tramways; "Hours of Labour of Tramway Employés," by Mr. A. Baker, chief officer of the London County Council Tramways; "Permanent Way Construction and Maintenance; Tramway Conditions in America and Great Britain Compared," by Mr. C. R Bellamy, manager Liverpool Corporation Tramways; and "Selection and Training of Motormen and Conductors," by Mr. L. Mackinnon, traffic superintendent, Glasgow Tramways. The members of the Conference are to be officially received by the Glasgow Corporation, and entertained to a civic dinner. On the 9th the party visit Pinkston Power Station of the Glasgow Tramways, and the same evening the annual Association dinner takes place. The concluding day is to be given over to a trip by the new turbine steamer to Inverary, the seat of the Duke of Argyle.

Mr. Chamberlain's Scheme and the Engineering Trades.—At a meeting of members of Parliament and others connected with the iron, steel, mechanical, and electrical engineering trades, held in one of the Committee rooms of the House of Commons on June 25th, Mr. E. Windsor Richards presiding, it was resolved, on the motion of Colonel Charles Allen, seconded by Sir A. Hickman, M.P.:—

"That, having regard to the present public discussion as to possible fiscal changes, it is desirable that a committee of those interested in the iron and steel manufactures and in the construction of all kinds of machinery be formed for the purpose of calling attention to the unfair and illegitimate competition arising from hostile tariffs, trusts, and cartels, to which those trades are subjected; and to that end, and in anticipation of possible negotiations with foreign and Colonial Governments, reliable information should be invited from manufacturers, to enable Parliament and the country generally to correctly appreciate the serious injury which threatens British manufacturing industries."

A committee, with Sir Joseph Lawrence, M.P., as hon. sec. (*pro tem.*), was appointed, on the motion of Mr. Hardy, M.P., seconded by Mr. Alfred Baldwin, M.P.—*The Times.*

Congratulations.—Not many of the birthday honours came the way of those associated with electrical or engineering professions and callings. We might almost say that science was given the cold shoulder. We note a very gratifying exception in the case of Mr. John Gavey, the very genial engineer-in-chief of the General Post Office. Those who know Mr. Gavey and the sterling value of the services he has rendered to his department and to the country, will readily concede that his appointment to be a Companion of the Most Honourable Order of the Bath (Civil Division) is as well merited as the honour given to any other gentleman whose name appears in the list. He is a man of most excellent scientific attainments and personal qualities, is a Government official who knows what hard work means, and is by no means lacking in backbone. His presence is an assurance for the harmonious working of the engineering department, over whose very extensive operations he exercises a thorough supervision.

We also congratulate the following gentlemen upon appointment to the Imperial Service Order, which his Majesty recently instituted for members of the Civil Service as a recognition of long and meritorious service:—

Mr. W. R Culley, superintendent, Submarine Telegraph Branch, General Post Office.

Mr. S. C. Hooley, Controller of Stores, G.P.O.

Mr. E. Trenam, Controller, Central Telegraph Office, G.P.O.

Overhead Electric Wires.—In the House of Commons on June 24th, Mr. Markham asked the President of the Board of Trade what were the present regulations restricting the use of high voltage currents carried on bare wires over or on public roads; and whether, seeing that currents of 10,000 to 40,000 volts were carried by overhead bare wires on the Continent and in America to the advantage of the industrial community, he would consider whether a pressure of 10,000 volts could now be permitted, provided that efficient cradles or guard, of a type approved by him, were employed to protect such wires; whether he had any information showing that high tension bare wires carrying high voltage current had ever caused any injury or loss of life to the public in America and on the Continent, when used only for transmitting power to substations; and that the dangers to the public, if any, were not greater where bare wires transmitted current direct to tram motors than in the case where the line was never in contact with a moving collector.

The *Standard* quotes the following reply made by Mr. Law:—"The Board of Trade have not yet made any regulations relating to the transmission of electricity at high voltage by bare overhead wires. I have no information as to injury or loss of life to the public caused by bare wires carrying high voltage supply in America or on the Continent, or as to the relative dangers to the public from wires used for tramways (where constructed under Board of Trade regulations) and from those used for other purposes. Two schemes have recently been submitted, and are now before the Board's electrical adviser, who has been instructed that the promoters may proceed with their works step by step under his supervision. The Board propose to give their best consideration to applications for the use of high voltage, dealing with each case on its merits."

Electrical Wonders in the Daily Press.—We are tired of exposing the absurdities perpetrated by the editors and correspondents of the daily papers in technical matters, and were it not for a sense of duty, not unmixed with indignation, we should spare our readers from the recital of their iniquities. The deficiencies of our system of so-called education, which too often appears to be confined to dead languages, ragging, &c., are painfully evidenced when the non-technical journalist comes in contact with the phenomena of physical science, his information on such matters seemingly extending no further than the glass cylinder frictional machine and the common pump. Hence it is, no doubt, that in the *D.T.* of Tuesday last "Our Own Correspondent" in New York describes to an astonished audience the wonders of high-frequency currents, with which electricians were familiarised by Tesla years ago. The origin of this outbreak was a demonstration at the University of Michigan, where, we are told, "the fatal current of 5,000 volts" was transformed up to 500,000 volts, with 800,000 alternations per second, and became harmless and agreeable. "The effect was tremendous!"

Again, in the *D.M.* of Wednesday, "Our Own Correspondent"—this time in Chicago—states that a Frederick Schoonmaker is arranging to "fire a spherical magnet towards the sky. To the projectile will be attached a coil of wire 20 or 30 miles in length." It is supposed that "once it is beyond the pale of the law of gravitation, the magnet will be drawn into the electric sea surrounding the earth and held there. By means of the wire it is hoped that a limitless supply of electric power will be obtained." The *D.M.* correspondent calls this "a novel experiment"; somewhat to our surprise, we were unable to find a leaderette pointing out the marvellous benefits which will be derived from the epoch-making invention, or lamenting our backward state as compared with America in the world of science. It is not long since an article a column long in the *D.M.* was filled with extravagant balderdash about the terrors of the sub-stations on the Central London Railway, compared with which, it would seem, hell itself would pale its ineffectual fires. Why, in the name of reason, are not these wild screeds submitted to some first year student at a technical college for criticism, instead of being printed without a word to indicate to the public their utter worthlessness?

International Telegraph Conference.—On Saturday last a delightful day was spent by the delegates to the Telegraph Conference in visiting Kenilworth, Warwick and Stratford-on-Avon; the excursion was organised and carried out by the India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd., of Silvertown, and it is therefore superfluous to add that the arrangements made for the comfort of the guests were perfect.

The foreign delegates left Euston at 9 a.m. for Kenilworth, whence they proceeded by road *vid* Guy's Cliffe to Warwick Castle. Here they joined a party composed of the directors of the company and their friends, who were conveyed from London by a special dining-car train chartered by the company, *vid* the Great Western route through Reading. After visiting the Castle, where the private rooms were thrown open to the visitors as a special favour, the guests were received by the Earl and Countess of Warwick at the main entrance, and the Earl in a brief address bade them a hearty welcome. The party then strolled through the grounds of the Castle, and afterwards were entertained to luncheon in a marquee set up in the Park, the Silvertown Company being the hosts. During luncheon the band of the Scots Guards performed a programme of national airs. A vocal concert given by the Novello-Davies Part-Singers followed. The party then divided, the delegates proceeding to Stratford-on-Avon by road, whilst the rest of the visitors returned to London in a special train on the L. and N.-W. Railway. At Stratford, Shakespeare's birthplace, the Church and the Memorial Hall were visited, after which the party returned to London, dining *en route*.

There were about 130 in each party, or 260 in all. Amongst the Foreign delegates were:—

M. le Colonel Frey, Director of the Berne International Office;
M. Sydow, delegate for Germany;
M. le Baron Alfred Fries, Austria;
M. J. Banneux, Belgium;
M. N. Meyer, Denmark;
Senor D. Primitivo N. Vigil, Spain;
M. le Chevalier Rodano, Italy;
M. le Dr. Hennyey de Hennye, Hungary;
M. Sins, France;
M. le Conseiller A. Pereira, Portugal;
M. M. R. Sahlin, Sweden; and
M. Fehr, Switzerland.

The weather was perfect, and the entertainment was in every way most enjoyable. We must not forget to mention a souvenir of the visit, prepared, we believe, by Mr. Cronch, secretary of the Silvertown Co., in which the historical associations connected with the places visited were set forth in a light and interesting style of high literary merit.

Appointments Vacant.—A teacher of electric wiring for one evening per week at Southend Technical School; shift engineer for Ilford electricity works (35s.); a teacher of electric wiring for the Acton and Chiswick Polytechnic (one evening per week); assistant electrical engineer for Llandudno (£100); engineer for the Llandrindod Wells E.L. & P. Co. at £125. See "Official Notices" to-day.

Errata.—We are informed that the four Berryman feed-water heaters installed at the Stuart Street (Manchester) Electricity Works were made by the Sir Hiram Maxim Electrical and Engineering Co, Ltd., as part of their contract for the pipework, pumps, &c., and that they are not the largest size made. Also a large number of the valves used were supplied by Messrs. Templer & Ranoe, Ltd, of their patent "stop and isolating," "Sterling," "Dure," and "T. R." types, through the contractors for the boilers and pipework.

Personal.—A farewell dinner was given on the 25th ult. at the Frascati Restaurant to Mr. L. L. Hartvigson, engineer in England of the Great Northern Telegraph Co., on the occasion of his leaving London shortly in order to take over the appointment of superintendent of the company's cable station at Newcastle-on-Tyne. Mr. F. C. C. Nielsen, the Great Northern Telegraph Co.'s representative in England, presided, and some 60 gentlemen were present. After loyal toasts, the chairman proposed the health of the guest of the evening, dwelling upon Mr. Hartvigson's abilities and the important and responsible position he has held during his long term of service in London. Mr. Hartvigson can show 30 years' service with the company, the last 20 years of which have been passed uninterruptedly in London. Mr. Hartvigson returned thanks, and said he would always look back with sincere pleasure to his warm welcome that evening. Mr. J. P. Hooper, recalled his father's and his own connection with the company when the first cables in the Far East were laid by the original firm of Hoopers, and Mr. George Sutton, managing director of Henley's, referred to Hr. Hartvigson's strict and unvarying attention to the company's interests. Amongst those present were: Mr. Th. Rasschou, Acting Consul General for Denmark in England, Mr. St. A. Bille (Copenhagen), Lieut. J. J. Bahnson, Messrs. C. F. Venndt, G. Maiklereid, W. Potter, Fred Hooper, and Harold Ohlson. The enjoyment of the evening was enhanced by selections on the violin and piano rendered by Messrs. Rasschou, Axel Larsen and Michaelsen.

Mr. E. B. Schattner, who has joined the staff of the General Electric Co., of America, was presented with a handsome address and present by the staff of the Schattner Electricity Meter Co., Ltd, on the occasion of his departure.

Our sincere congratulations to Mr. A. M. Thompson, M.Inst.C.E., M.I.E.E., signal superintendent to the London and North-Western Railway, at Crewe, who has been appointed electrical engineer to the company, from July 1st, in succession to Mr. J. W. Fletcher, who retired from the service on that date. Mr. Thompson will, in addition to his present duties, take charge of the electrical and telegraph work. His office will be at Crewe.

THE CENTRAL STATION ENGINEER.

On June 18th, the Lowestoft Electricity Works' staff went for their annual outing. The party numbering 36, and including Mr. G. A. Bruce, the borough electrical engineer, proceeded by the *Atalanta* up the river to Cantley. Dinner was served at the Coldham Hall Hotel.

Mr. W. J. Sowter, chief assistant at Coventry Corporation Electricity Works has been appointed borough electrical engineer at Dorchester.

Gillingham (Kent) U.D.C. has engaged the resident electrical engineer (Mr. A. D. Chalmers) on the following terms:—Three years' engagement, £250 per annum for the first year, £300 for the second, and £350 for the third, with half the premium of one articled pupil.

The Burton-upon-Trent Corporation having appointed Mr. P. J. Pringle to the position of borough electrical engineer and tramways manager, Mr. F. L. Ramsden's duties and responsibilities, so far as the electric light is concerned, have ceased. Further communications on this subject should therefore be addressed to Mr. Pringle.

Out of 106 applicants, Mr. H. Waring, of Mexborough, has been appointed resident electrical engineer at Todmorden, at £250.

At the monthly meeting of the Derby Town Council, held on Wednesday, July 1st, Mr. A. Butterworth, J.P. (chairman of the Electric Lighting Committee), proposed that the salary of Mr. T. P. Wilmshurst (electrical engineer) be increased from £500 to £650 per annum. He said that a few weeks ago Mr. Wilmshurst applied to him for a testimonial as an applicant for the post of electrical engineer at Birmingham. He consulted with Alderman Duesbury, the chairman of the Tramways Committee, as they were about to electrify the trams, and they came to the conclusion that if they could retain his services it would be a very wise thing for Derby. He referred to Mr. Wilmshurst's work during the time he had been in Derby, and said that when he came there the works were in about as poor and bad a condition as electrical works could be, but by his own sagacity and knowledge he had remedied this and turned a rotten concern into a sound one. He pointed out that the Tramways Committee had arranged to pay the Electric Lighting Committee £150 per annum for the next three years in consideration of Mr. Wilmshurst's services in connection with the electric tramway scheme—Mr. A. Wilson seconded. Mr. G. Foster objected strongly to the proposal, and said he would neither be coerced nor cajoled into voting for an increase to any official by the threat of his leaving if they did not make it worth his while. A long discussion followed during which it was stated that Mr. Wilmshurst came to Derby from Halifax less than five years ago, and in the meantime his salary had been raised by £150. In the end the motion was defeated by 23 votes to 22.

NEW COMPANIES REGISTERED.

Universal Insulator, Ltd. (77,770).—This company was registered on June 20th, with a capital of £10,000 in £1 shares, to adopt an agreement with L. Grote and E. Perry, to manufacture, buy, sell, let on hire, licence or royalty, or otherwise deal in electric insulators and moulded articles of any kind, and to carry on the business of mechanical and electrical engineers and manufacturers, machinists, fitters, founders, smiths, wire drawers, rubber manufacturers, cutlers, ironmongers, platers, &c. The first subscribers (each with one share) are:—J. Brockelsby, 32, Old Jewry, E.C., clerk; H. Spinks, 45, Roding Road, Homerton, N.E., clerk; A. D. Brown, 31, Reighton Road, Upper Clapton, shorthand writer; H. E. Richardson, 67, Shepherd's Bush Green, W., clerk; J. W. Pollard, 11, Hartwood Road, Wendall Park, Shepherd's Bush, W., clerk; D. J. Prosser, Lovett Villa, Devonshire Road, Merton, S.W., clerk; and G. E. Saunders, 51, Larkfield Road, Richmond, Surrey, clerk. No initial public issue. The number of directors is not to be less than two nor more than three; the first are E. Perry (managing director), and others to be appointed by the subscribers; remuneration according to the sales.

Henley's (South Africa) Telegraph Works Co., Ltd. (77,781).—This company was registered on June 22nd, with a capital of £2,000 in £1 shares, to carry on in South Africa or elsewhere the business of electricians, telegraph and telephone engineers and contractors, submarine, cable and telegraph and telephone instrument manufacturers, wire drawers, galvanisers, wire rope makers and engineers, producers of light, heat or power by electricity, galvanism, or magnetism, &c., in S. Africa or elsewhere. The first subscribers (each with one share) are:—S. Gedge, 11, Great George Street, Westminster, solicitor; F. Newton, 9, Warrington Crescent, Warwick Road, Paddington, gentleman; G. Sutton, 27, Martin's Lane, Cannon Street, E.C., electrical engineer; W. J. Potter, 21, Princess Avenue, Muswell Hill, N., secretary; J. V. Butler, 27, Martin's Lane, E.C., clerk; C. E. Lifeaux, 27, Martin's Lane, E.C., clerk; and F. J. Bettley, 27, Martin's Lane, E.C., clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification and remuneration as fixed by the company. Registered office, 27, Martin's Lane, Cannon Street, E.C.

Bruce Peebles & Co., Ltd. (5,383).—This company was registered in Edinburgh on June 24th, with a capital of £200,000 in £5 shares, to acquire the business now carried on in Edinburgh, London, Cardiff, Manchester, Newcastle-on-Tyne, and elsewhere, as D. Bruce Peebles & Co., and to carry on the business of electricians, mechanical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—W. C. Peebles, Hope Park, Trinity, Edinburgh, engineer; A. C. Peebles, Hope Park, Trinity, Edinburgh, engineer; R. S. Portheim, 37, Victoria Street, S.W., engineer; M. T. Pickstone, Tay Works, Edinburgh, engineer; H. Mungall, 20, Royal Terrace, Edinburgh, coalmaster; J. R. Peebles, Hope Lodge, Trinity, Edinburgh, engineer; I. M. Somerville Shaw, 17, St. Andrew's Square, Edinburgh, stockbroker. The number of directors is not to be less than three nor more than seven; the first are W. C. Peebles, A. C. Peebles, R. S. Portheim, M. I. Pickstone, and H. Mungall. Registered office, Tay Works, Bonnington, Edinburgh.

ELECTRICITY SUPPLY ACCOUNTS.

Stockton Municipal Electric Supply.

The accounts of the Stockton Electrical Department just issued record the second complete year's work. From the analysis given below it will be seen that the undertaking is making steady progress—the output having increased 47 per cent. on the previous year without appreciably affecting the average price obtained, and this has been accompanied by a decrease of over a ½d. per unit in generating costs; the gross profits have consequently reached nearly 2½ times the previous year's amount.

The load factor during the year was 10·5 per cent., and the total works cost, rather over 2½d. per unit sold, figures which compare well with other local undertakings of similar age.

Situated as these supply areas are, in a coal producing and manufacturing district, there is no reason why the motive power and private lighting supplies should not be more equally divided; when the works costs would not be more than half their present figure. Doubtless, central station engineers are well aware of this fact, but the situation points to an amazing lack of appreciation of the essential conditions of cheap supply on the part of many of the Lighting Committees composed of so-called business men. Of the total 299,980 units sold, public lamps took 68,491 units (there being 44 arcs for street lighting). The prices charged for private lighting are 6d. and 2½d. per unit on the maximum demand system, and for power 2d. to 1½d. per unit. The borough electrical engineer is Mr. J. J. Smith.

General Statement.

For year ending March 31st—		1902.	1903.	Inc.
Total capital expended		£35,534	£47,679	£12,145
Number of units sold		205,322	299,980	94,658
Equivalent number of 8-c.p. lamps		11,856	17,179	5,323
No. and h.p. of motors		12 motors =35 h.p.	18 motors =68 h.p.	6 motors =33 h.p.
Maximum load in kw.		261	323	62
Revenue Account.	Gross revenue	£3,406	£5,024	£1,618
	Gross expenditure	£2,643	£3,159	£516
	Gross profit	£763	£1,865	£1,102
Average price per unit sold		3·98d.	4·03d.	·05d.

Middleton Corporation Electric Supply.

Revenue Statement.

	1901-2. Gross.	Per unit.	1902-3. Gross.	Per unit.	Inc.
By sale of energy	£3,316	3·88d.	£4,889	3·93d.	·05d.
Meter rents, &c. ...	90	·10d.	135	·10d.	·00d.
Gross revenue	£3,406	3·98d.	£5,024	4·03d.	·05d.

Cost of Production.

	1901-2. Gross.	Per unit.	1902-3. Gross.	Per unit.	Inc.
Coal, &c.	£719	·84d.	£841	·67d.	—·17d.
Oil, waste, water and engine-room stores	169	·20d.	197	·16d.	—·04d.
Wages incurred in generation and distribution	808	·94d.	578	·46d.	—·48d.
Repairs and maintenance of buildings, machinery and plant	184	·21d.	387	·31d.	+·10d.
Works and distribution costs	£1,880	2·19d.	£2,003	1·60d.	—·59d.
Rents, rates and taxes	254	·30d.	273	·22d.	—·08d.
Management expenses, including salaries, engineer, and clerical staff	356	·42d.	481	·39d.	—·03d.
General establishment charges, printing, stationery, insurance, law and sundry	153	·18d.	402	·31d.	+·13d.
Total works costs	£2,643	3·09d.	£3,159	2·52d.	—·57d.

Profit Statement.

	1902.	1903.
Interest on loans	£747	£1,165
Sinking fund	835	1,415
Credit balance from 1901	—227	—
Debit balance	—592	—715
Gross profit	£763	£1,865

On the year's working a gross profit of £1,865 was earned, and after meeting financial charges, which were much higher than in the preceding year, there remains a deficiency of £715.

The returns for the first year's working of the Middleton electrical undertaking show that a surplus of £134 remains after meeting working and financial charges. This satisfactory result is attributable to the fact that over 90 per cent. of the units were supplied for traction, and to the department being well situated in regard to a cheap fuel supply. The total works costs amount to ·90d. per unit, the largest item, fuel, being ·32d. Although these figures are undoubtedly low, both the load factor of 17 per cent. and the works costs are capable of further improvement, taking into account the possible developments in motive power, which a manufacturing district facilitates.

The prices charged were:—For private lighting, 5d. to 4d. per B.T.U.; power, 2d. to 1½d.; traction, 1½d. to 1d.

Mr. S. Pauls is the borough electrical engineer.

General Statement.

For the year ending March, 1903.

			Av. price obtained.
Total capital expenditure		£36,551	
Number of units sold.	Private supply	40,026	4·08d.
	Public ,,	9,000	3d.
	Traction ,,	634,544	1·39d.
Total number of units sold		683,570	—
Equivalent number of 8-c.p. lamps		4,186	—
Number of public lamps		9 arcs	—
Number of motors and horse-power		5 = 8 H.P.	—
Revenue Account.	Gross revenue	£4,504	—
	,, expenditure	£2,569	—
	,, profit	£1,935	—
Average price obtained per unit sold		1·58d.	—

Revenue Statement.

	Gross.	Per unit.
By sale of energy	£4,477	1·58d.
Meter rents, &c.	27	·00d.
Total revenue	£4,504	1·58d.

Working Expenses.

	Gross.	Per unit.
Coal and other fuel, including cartage	£908	·32d.
Oil, waste, water and engine-room stores	175	·06d.
Wages of workmen	798	·28d.
Repairs and maintenance of buildings, generating and distributing plant, &c.	66	·02d.
Works and distribution costs	£1,947	·68d.
Rent, rates and taxes	149	·05d.
Management expenses, salaries engineers' department, collectors, accountants and clerical staff, stationery, printing, law charges, insurance, and general establishment charges	473	·17d.
Total costs	£2,569	·90d.

Profit Statement.

Interest on loans, &c.	£1,089
Sinking fund	712
Balance carried forward	134
Gross profit	£1,935

On the year's working the department made a gross profit of £1,935; and after meeting financial charges, a surplus of £134 remains—an excellent, though not, under the circumstances, unlooked-for, result.

CITY NOTES.

J. G. White & Co., Ltd.

Lord Arthur Butler presided at the meeting of this company, held on June 29th at 22A, College Hill. He said that the profit and loss account showed a balance of profit for the half-year ended February 28th, 1903, of £14,628, which compared favourably with former results. After bringing forward the balance from the last report—namely, £11,469 18s.—the total to the credit of profit and loss was £26,098. On the credit side of the balance-sheet the item "Purchase of business" stood at the same figure as at August 31st, 1902. Included in this figure was the cost of the goodwill of the business; and the policy of the directors was to provide for the gradual extinction of this amount by the creation of a reserve fund. Sums would be set aside from time to time out of the profits for this purpose, and it was recommended that £5,000 be set aside out of the present half-year's profits. Generally speaking, the accounts showed a distinct advance in the position of the company. The capital had hitherto proved sufficient for the company's construction business, but recently several favourable propositions had been under consideration, in which the question of financial assistance was an important factor, and the directors might find it advisable, in order to extend the scope of business, to propose a further increase in the capital of the company. The outlook for new business for the current year was distinctly good. With regard to the proposed method of declaring dividends, the result of the half-year's trading quite justified the declaration of a 10 per cent. dividend on both classes of shares; but if this plan were adopted without explanation, shareholders would, no doubt, look for a continuance of dividends at the same rate, and this, the directors considered, when coupled with the necessity for providing a reserve fund, might be placing too heavy a burden upon the resources of a young company. For this reason, it was proposed to adopt the policy of declaring a dividend at a rate which the directors considered, from the business outlook, the company would be able to maintain for the ensuing year, and a special dividend, based entirely on the results of the trading in the past half-year.

Mr. A. N. Connett seconded the adoption of the report, which was carried unanimously.

The Chairman also moved that dividends be sanctioned and declared as follows:—

(*a*) A dividend, free of tax, at the rate of 8 per cent. per annum on the 6 per cent. cumulative preference shares for the half-year to February 28th, 1903, absorbing £8,258 13s. 4d.; (*b*) A dividend, free of tax, at the rate of 8 per cent. per annum on the ordinary shares for the half-year to February 28th, 1903, absorbing £2,000; (*c*) A special dividend, free of tax, at the rate of 2 per cent. per annum on the preference and ordinary shares for the half-year to February 28th, 1903, absorbing £1,614 13s. 4d.

This was unanimously agreed to.

The sum of £5,000 was allocated to reserve fund, and £14,525 2s. 3d. was carried forward to the next account.

The retiring directors (Lord Arthur Butler and Mr. A. N. Connett) were re-elected.

Electrical Power Storage Co.

The directors' report to May 31st, 1903, to be presented at the meeting on July 9th, reads:—

The profit for the year, including the balance of £854 14s. 9d. brought forward, is £11,983 17s. 10d. Out of this sum the directors have carried £5,000 to the reserve fund and £1,000 to the contingent fund. They recommend the payment of a dividend of 6 per cent. on the ordinary share capital, which will absorb a further £5,399 13s. 7d. and leave £584 4s. 3d. to be carried forward. The buildings, plant, tools, &c., have been maintained in thorough repair and condition at a cost of £3,502 9s. 8d., which sum has been provided out of revenue. The directors have again to record an increase in the business, the output having exceeded that of any previous year. Every type of cell has been represented in the increase, power, lighting, automobile, and launch cells having all been in larger demand. In consequence of the numerous orders received, especially for the company's largest types of cells, it has been found necessary to increase the forming space at the works. A new floor has, therefore, been added to the main shop at Millwall, to enable the company to keep pace with the orders received. During the year the company has installed batteries in many of the largest central stations in the kingdom, and the number of repeat orders received affords most satisfactory evidence of the efficiency and value of the company's manufactures. The retiring director is Mr. Frederick Green, who offers himself for re-election.

Rand Central Electric Works, Ltd.

The annual meeting of this company was held at Winchester House, E.C., on Thursday of last week.

The Chairman (Sir C. Rivers Wilson), in moving the adoption of the report, said that he hoped the shareholders would consider the report in the light of the circumstances which prevailed during the

period under review. It was not until June that the military guard in charge of the works was withdrawn, and they would understand that the war had affected the company's operations during the whole of the year 1902. The company had suffered through scarcity of native labour, as had other companies, as well as through difficulties of transport, which were due to military restrictions. Their prosperity had also been affected by their principal customers, the mines, having been unable to resume operations to their full capacity. There could be no doubt, however, that as soon as the labour difficulty had been settled and the mines were again in full working order, the output of power would be increased. Turning to the financial side, he said they would see from the statement of accounts that there had been a gross profit of £14,188 17s. 11d., and, after deducting £11,950 15s. 2d. for depreciation, there was a remaining net profit of £2,238 2s. 9d. That reduced the debit balance of £25,231 9s. 10d., which was the amount brought forward on December 31st, 1901, to £22,993 7s. 1d. The balance of the company's claim against the Imperial Government in respect of damage done to their plant by the Boers amounted to £2,793. As yet that claim had not been very favourably received, although he considered that it was a very equitable one. He had been given to understand that the Government adopted the principle that compensation might be given to individuals, but not to corporations. In his opinion, there was not reason for making such a distinction. The company's works had been attacked in consequence of the assistance which they were able to render to the military authorities, and he thought that that was very good ground for their application for compensation. Prior to the outbreak of hostilities the company had contracts with mines using 980 stamps. Of these mines only 225 were working at the commencement of the year under review. The number had been gradually increasing, until it had reached 530 at the end of December last. As soon as the mines were able to use the full amount of power contracted for, and as soon as other contracts which were under consideration had been concluded, the company's plant would be taxed to its utmost capacity. The total amount of power distributed during the past year was 7,123,720 KW.-hours. The board had come to the conclusion that the time had arrived when they should provide additional plant, and with that object they had ordered a fifth engine, the cost of which was expected to be £30,000, but they had made arrangements to find the money without having to call on the general body of the shareholders. He considered that the prospects of the company were decidedly good, for new fields were being opened up in the direction of their works, and that fact alone pointed to a probability of their being required to meet a demand for a considerably larger amount of power.

Mr. G. ZWILGMEYER seconded the motion.

Mr. A. BRAKHAN, who, until recently, was chairman of the local board, dwelt upon the prospects of the company at some length. He congratulated the board upon having erected additional generating plant, and said he felt confident that the increased energy which they would thus be able to supply would be required by the mines and other consumers. The mining industry, which included their best customers, was at present in a dormant condition to a great extent owing to the scarcity of labour, but he felt confident that sooner or later labour would be got. They had already had the assurance from some companies which were now laying out their works that they would make use of the company for obtaining their power.

The report was then adopted.

British Aluminium Co.

THE report states that the profit for the year ended December 31st is £20,770. This is insufficient to meet the debenture stock interest, depreciation on plant, &c., and charges on stocks of metal by £3,392, and the debit balance has therefore been increased by this sum to £22,357. In accordance with the arrangements made with the debenture-holders last autumn, payment of interest due on November 1st, 1902, and May 1st, 1903, was postponed, and deferred warrants have been issued to the stockholders for the amounts accrued due to them. The £10,000 authorised to be raised in priority to the debenture stock was borrowed in January last, and £2,000 has since been repaid. The sales of aluminium continue to increase so satisfactorily that the board has deemed it necessary to take steps to extend the water-power installation at Foyers by the erection of two more dynamos, and to increase the capacity of output of the several works of the company. These extensions will involve considerable expenditure, which the board hopes to provide without making any fresh issue of capital or increasing the debenture debt. A considerable reduction in the cost of the manufacture of carbide has been effected, which justifies the company in continuing this branch of the business.

Urban Electric Supply Co.

IN their annual report the directors state that the stations at Stamford, Hawick, Twickenham, Weybridge, Godalming, Dartmouth, and Camborne and Redruth, and the tramway between the two latter places, were completed and opened during the year. Although these stations were running for an average period of less than six months, the profit derived therefrom amounted to £2,264. After adding interest on loans and deposits and deducting London expenses, including directors' fees and interest on calls paid in advance, there remains a balance of profit of £1,371, dividends guaranteed by the Edmundsons Electricity Corporation, Ltd., under their agreement amounted to £6,697, and after deducting the above profit, the balance of £5,326 has been duly provided by them.

Electric and General Investment Co., Ltd.

THE following is the directors' report for the year ended May 31st, 1903. (The meeting is to be held on July 8th):—

The profit and loss account shows a gross profit on the transactions of th year of £19,424 10s. 5d. After deducting all general charges and the interim dividends already paid on the preference and ordinary shares, and providing for the proportion of the final dividend accrued on the preference shares to May 31st, 1903, there remains a net balance of £8,996 19 7
to which the directors propose to add, by transfer from "provision for contingencies" £1,003 0 5
making a total of £10,000 0

The directors recommend that this amount of £10,000 be distributed as follows:—

Ordinary Shares—To the payment of a dividend of 5s. per share for the year ended May 31st, 1903, of which 2s. per share was paid *ad interim* in December, 1902, leaving 3s. per share to be paid on July 8th, 1903	£3,000 0 0
To the payment of a bonus of 2s. per share for the year ended May 31st, 1903	£2,000 0 0
Founders' Shares—To the payment of a dividend of £50 per share for year ended May 31st, 1903	£5,000 0 0
	£10,000 0 0

The trustees for the ordinary shares reserve fund propose to distribute to the holders of such shares a sum of 6d. per share, making, with the above-mentioned dividend and bonus, a total present distribution of 5s. 6d. per share, or 7s. 6d. for the year on each ordinary share. The trustees for the founders' shares reserve fund propose to distribute to the holders of such shares a sum of £5 per share, making, with the above-mentioned dividend, a total distribution of £55 on each founders' share for the year. The above-mentioned payments will be subject to the deduction of income-tax. Mr. George Herring retires from his office as a director by rotation, and, being eligible, offers himself for re-election.

Greenwood & Batley, Ltd.

THE report for the year ended March 31st states that, after providing for debenture interest and expenses of management, and making provision for doubtful accounts, the accounts show a profit of £19,178, which, added to £3,026 brought forward, makes a total of £22,204. The directors have written off £5,000 for depreciation, and recommend a dividend for the year at the rate of 4 per cent. per annum on the paid-up ordinary share capital, leaving £3,306 to be carried forward. The buildings, plant, and machinery have been maintained in efficient working order and condition, £7,493 having been expended during the year on maintenance account and charged to revenue.

Prospectuses.

MESSRS. MELDRUM BROS., LTD., are before the public with an issue of 25,000 5½ per cent. cumulative preference shares of £1 each to rank equally with the original preference shares which were issued when the company was formed in 1900. The great progress which this company has made during the past few years in refuse destructor plant, forced draught furnaces, mechanical stokers, &c., is quite well known, and larger works at Timperley had to be erected to keep pace with the advance. The present issue is for the purpose of providing additional working capital. The list of applications is to close to-day, Friday.

Subscriptions are invited, until July 6th, for an issue of 10,000 6 per cent. cumulative preference shares of £5 each in the South Staffordshire Tramways (Lessee) Co., Ltd. The issue is made to provide for the cost of reconstruction for electric traction on certain sections, for the purchase of electric cars, and other purposes. The issue has been underwritten by the British Electric Traction Co.

British Electric Traction Co.

THE directors' report for the year ended March 31st, 1903, to be presented to the meeting, to be held at Hamilton House, Victoria Embankment, E.C., on Wednesday, July 8th, reads:—

Profit and Loss Account.—The profits, including £27,438 7s. brought forward from last year, amount to £266,399 18s. 10d. This does not take into account the premiums, amounting to £90,337 4s. received in respect of new share and debenture capital, which have been carried direct to reserve. After deducting the proportion of general expenses chargeable to revenue, and also the expenses incurred in connection with schemes not proceeded with and written off, contributions to superannuation fund, and interest on debenture stock, there remains a net profit of £208,161 14s. 11d., which the directors propose should be applied as follows:—

Reduction of licences and testing of new systems account ..	£2,500 0 0
Reduction of furniture account	551 13 7
Dividend at the rate of 6 per cent. per annum on the preference shares for the year ended March 31st, 1903, including the dividend paid to February 15th, 1903, and proportion of dividend payable August 15th, 1903, accrued to date	74,760 9 7
Dividend at the rate of 10 per cent. per annum on the ordinary shares for the half-year ended March 31st, 1903, making, with the interim dividend at the rate of 6 per cent. per annum, paid for the half-year ended September 30th, 1902, a total distribution of 8 per cent. for the year	105,437 0 9
Carried forward to next account	24,912 11 0
	£208,161 14 11

The reduction of the dividend on the ordinary shares by 1 per cent. for the year is mainly due to a larger amount of new capital having been raised during the past year which has not yet become productive of profit, though ranking for dividend.

Capital Account.—In June, 1902, 20,000 ordinary shares were allotted to the shareholders at par in accordance with the proposal approved by the shareholders, and contained in the last annual report of the directors. In November last an issue was made of

75,000 preference shares at the price of £12 per share. 37,500 shares of this issue were underwritten for a commission of 10s. per share, and 37,500 shares were allotted. A further 3,213 ordinary shares, and 11,447 preference shares have also been issued as fully paid up, to the holders of 32,130 ordinary shares and 68,682 preference shares of the Brush Electrical Engineering Co., Ltd., in exchange for their shares in the Brush Co. There have been issued as fully paid up 8,853 ordinary shares and 7,490 preference shares, in exchange for shares in the Electrical Power Distribution Co. The absorption by the company of the Electrical Power Distribution Co. has been completed, and the latter company is now in course of liquidation. There has also been issued £212,912 5 per cent. perpetual debenture stock, and £35,754 5s. 8d. has been received on account of further stock to be issued. The total premiums received in respect of these issues, after deducting the expenses, amount to £90,337 4s., and the whole of this amount has been added to reserve, which, at the date of the accounts, stood at £550,042 8s. 10d. The subscribed share and debenture capital at March 31st, 1903, was:—£1,320,660 in ordinary shares of £10 each; £1,564,370 in 6 per cent. cumulative preference shares of £10 each; £1,023,818 in 5 per cent. perpetual debenture stock = £3,908,848.

Contracts and Undertakings.—The balance under this head, after deducting the cost of undertakings transferred, and after writing off expenses incurred in respect of schemes not proceeded with, but including a proportion of general expenses, is £214,040 0s. 8d., made up as follows:—

Expenditure on works and undertakings for account of other companies	£36,827	8	5
Expenditure on works and undertakings owned or leased by the B.E.T. Co., and for general stores, £116,744 2s., less reserved £4,000 .. .. =	112,744	2	0
Expenditure in connection with schemes in course of development, and on Acts of Parliament, Light Railway Orders, and other rights and powers secured or in course of promotion ..	64,468	10	3
	£214,040	0	8

Investments.—The total amount of investments, after deducting cost of securities sold, stands at £3,569,658 5s. 8d., and is made up as follows:—

£201,832 13s. 3d. Consols at cost	£198,143	15	7
Loans and other advances to associated companies and others, and deposits	217,041	11	6
£3,395,362 14s. mortgages, debentures and debenture stock and shares of associated and other companies, standing in the books at £3,164,472 18s. 7d., less reserved £10,000 .. =	3,154,472	18	7
	£3,569,658	5	8

N.B.—There are certain contingent liabilities in respect of some of the investments. A portion of the Consols is deposited with the Paymaster-General in respect of Acts of Parliament, &c.

Borrowing Powers.—The directors intend to ask the shareholders to increase the borrowing powers of the directors upon debentures or debenture stock up to an amount equal to the subscribed capital of the company. This will enable the directors to raise upon second debenture stock ranking subsequent in point of charge, an amount equal to the 5 per cent. perpetual debenture stock now authorised. The directors are of opinion that the security of the first debenture-holders will be improved thereby, and that the ordinary shareholders should benefit by a decrease in the average cost of the capital of the company.

Directors.—The Right Hon. Lord Rathmore has resigned his seat at the board. The directors who retire this year are Sir Charles Rivers Wilson, G.C.M.G., C.B., and Mr. John S. Raworth, and both are eligible for re-election.

Auditors.—In view of the increasing volume of the company's business, the directors consider the time has arrived for the appointment of an additional auditor, and a resolution will be submitted to the meeting that Messrs. F. W. Smith & Co. and Messrs. Deloitte, Dever, Griffiths & Co. be appointed the auditors of the company for the ensuing year.

A summary of the company's undertakings (illustrated with maps) is given in the appendix.

Charing Cross and Strand Electricity Supply Corporation.—Warrants for the interest on the 4 per cent. debenture stock of this Corporation were posted on July 1st. Warrants for the dividend on the City Undertaking 4½ per cent. preference shares were posted on June 30th.

Electric Construction Co.—The directors recommend a dividend on the ordinary shares, for the year ended May 31st last, at the rate of 6 per cent. per annum, one-half payable on July 31st, 1903, and the other half on January 31st, 1904.

City of London Electric Lighting Co.—An interim dividend on the ordinary shares of 5s. per share is announced.

Thomas Parker, Ltd.—The directors have resolved, subject to final audit, to declare a dividend of 6 per cent. for the year ending April 30th, 1903.

Cape Electric Tramways, Ltd.—The directors have declared an interim dividend of 6 per cent.

STOCKS AND SHARES.

Wednesday Evening.

Taking advantage of the midsummer quietude in the investment markets, we seize the opportunity to briefly review the course of quotations of the past half-year, and, in accordance with precedent, to present a representative record of the chief changes which have occurred since New Year's Day. It must be prefaced that whereas the Bank Rate then stood at 4 per cent. it is now 3, but the reduction has failed to bring about that revival in business that was fondly expected would take place upon the consummation of officially cheaper money. Although the war-borrowing is at end, the situation in South Africa remains unsatisfactory in consequence of the difficulties connected with the labour question, and Mr. Chamberlain's recent Protection proposals, apart from political issues, are calculated to give investors pause before embarking capital in stock markets that may be agitated by the influence of his suggestions.

Turning to details, the little electric railway market claims first attention, and the declines in the first three stocks are due to reasons fresh in the memory of all who study this column. We add the two Underground stocks to our list.

Stock.	Jan. 2, 1903.	July 1, 1903.	Rise or Fall.
Central London Ordinary ..	108¾	105½	3
" " Deferred ..	109½	108½	1
City & South London	76	71	5
Waterloo and City	95½	99½	4
Metropolitan Consolidated ..	91½	89½	2
Metropolitan District	38½	37½	1

Waterloo and City stock has improved on the prospect of better dividends in the future, and it is interesting to notice how slight have been the alterations in the two "Sewer" securities. London United Tramways Preference have advanced from 11½ to 11¾ *ex* dividend, and British Electric Tractions, which started the year at 12⅜, are now ¾ better at 13⅛.

In a dull six months it speaks well for the electric supply section that prices should show on a whole an improvement in value. There has been a steady demand for the best class of shares, and a still steadier absorption of Debenture stocks. New issues which have been made were eagerly snapped up in the majority of cases, and the strength of the market is well demonstrated by the annexed table, which contains the prices of a few representative Ordinary shares:—

Company.	Jan. 2, 1903.	July 1, 1903.	Rise or Fall.
Brompton and Kensington..	10½	10⅝	⅛
Charing Cross	9⅛	9½	⅜
Chelsea	5½	6¼	¾
City of London	10⅜	12	1½
Edmundson's	6⅜	6⅜	—
Metropolitan	16	18	2
Notting Hill	14½	14	½
St. James's	15	16	1
Smithfield	2½	3½	1
Westminster	11½	12½	1

In this section the principal interest of the half-year centred round the Metropolitan Electric Supply Co., and it will be noticed that the satisfactory character of the Marylebone award has left the shares better on balance, although the price is not now nearly as high as it was when the announcement became known.

Just lately the Telegraph market, after pronounced dulness, due to Marconi fears, has shown signs of faint revival, and it will be noticed by the following quotations, that the fall seems to have been stayed, for a time, at any rate. We must content ourselves with a very few examples:—

Stock or share.	Jan. 2, 1903.	July 1.	Rise or Fall.
Anglo-American Preferred ..	90	92	2
Ditto Deferred	8½	8¾	¼
Eastern Telegraph	117⅝	125⅝	8
Eastern Extension	10⅛	11¼	1⅛
Great Northern Telegraph ..	25½	23	2½
Western Telegraph	11½	11¾	¼
Reuter's	7	7	—

Globe Telegraph and Trust have remained all but motionless, but Submarines fell from 115 to 102 before they recovered to their present price of 113½.

National Telephone issues spurted sharply under the lead of the Deferred stock, which has risen from 68 to 83; the Preferred follows in more leisurely style, the present price of 103 comparing with 95 six months ago.

The Miscellaneous section of the electrical markets has been quiet in the extreme, and there are no fluctuations worthy of mention. But this department, in common with the others devoted to electricity, will probably move up quietly as the tide of general business begins to roll back to the long-forsaken Stock Exchange markets.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations June 24th.	Closing Quotations July 1st.	Business done week ended July 1st, 1903. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	97 —101	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅞ — 3⅛	2⅞ — 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	70 — 80	..	..
788,840	Anglo-American Telegraph	Stock	3½%	61s.	60/6	46 — 49	47 — 50	47⅛	46
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	91 — 93	92 — 94	92½	91⅞
3,105,580	Do. do. do. Deferred	Stock	5s. 6d.	2s.	1/-	8 — 8½	8½ — 8¾	8⅝	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	5 %	..	4¾ — 5¼	4¾ — 5¼	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	8 %	155 —165	150 —160 xd	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	90 — 93	89 — 92 xd	92⅜	91⅛
16,000	Cuba Telegraph	10	4½%	4 %	6½%	6½ — 7⅛	6¾ — 7⅛	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15⅜ — 15⅝	15⅝	..
12,931	Direct Spanish Telegraph	5	4 %	4 %	4 %	2¾ — 3⅛	2¾ — 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	98 —102	97 —101 xd	..	..
60,710£	Direct United States Cable	20	3½%	2½%	..	9 — 10	9⅜ — 10⅛	..	..
87,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	98 —101 xd	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	121 —126	124 —129	126½	123¾
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	85 — 88	87 — 90	89½	87
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	104 —107	104 —107	..	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	10½ — 11¼	10½ — 11¼	11⅛	11⅛
320,000£	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	105½	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 3,000, red. 1909	100	..	..	..	99 —102	99 —102	..	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	101 —104 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	5½%	..	8½ — 8¾	8½ — 9	8¾	8¾
180,042	Do. do. 6 % Pref.	10	..	..	..	11⅞ — 12⅛	12 — 12¼	12⅛	12
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	15 %	12½%	22 — 24	22 — 23	23	23½
62,500£	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —102	98 —101 xd	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	10%	35 — 39	35 — 39	38	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —104	100 —104	..	..
1,983,333	National Telephone, Pref. Stock	100	5 %	5 %	6 %	101 —103	102 —104	103½	102½
1,966,667	Do. do. Def. Stock	100	..	..	4½%	80 — 83	82 — 84	83¼	82½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 13	12 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	5⅛
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	98 —100	96 — 98 xd	..	..
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	103 —105	101 —103 xd	103¾	..
171,504	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6 %	⅞ — 1	⅞ — 1	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,829	Reuter's	8	5 %	5 %	..	6¾ — 7¼	6¾ — 7¼	..	..
3,308	Submarine Cables Trust	Cert.	..	..	..	101 —109	112 —117	114½	..
58,000	United River Plate Telephone	5	7 %	7 %	7 %	5¾ — 6	5¾ — 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4¾ — 5¼	4¾ — 5 xd	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	105 —108	103 —106 xd	..	..
15,609	West African Telegraph, Shares	10	..	..	2 %	4 — 5	4 — 5 xd	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	92 — 97	93 — 96 xd	94	..
267,930	Western Telegraph, Ltd., Nos. 1 to 267,930	10	7 %	7 %	..	11 — 12	11 — 11½xd	11⅜	11⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	97 —100	96 — 99	..	..
88,821	West India and Panama Telegraph	10	½%	..	..	⅜ — ½	⅜ — ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	6	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	3 — 4	3 — 4	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	97 —100 xd	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	3 — 4	3 — 4	..	..
300,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	74 — 79	74 — 79	..	..
100,000	British Electric Traction	10	9 %	9 %	8 %	13¾ — 14½	13¼ — 13¾	13⅛	13¼
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	12 — 12½	11¾ — 12¼	12¼	12
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	122 —125	122 —125	124⅜	..
100,000	British Insulated and Helsby Cables	5	15 %	10 %	10 %	6¾ — 7¼	6¾ — 7¼	6¾	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾ — 6	5¾ — 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red...	100	..	..	..	103 —107	101 —105 xd	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	8 %	Nil	..	9/16 — 11/16	9/16 — 11/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	6 %	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	5 %	Nil	Nil	¾ — 1⅛	¾ — 1⅛	¾	..
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	3 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	89 — 94	87 — 92 xd	..	..
35,000	Callender's Cable Construction shares	5	15 %	20 %	15 %	12 — 13	11½ — 12½	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5½ — 6	5½ — 6 xd	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	108 —112	106 —110 xd	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	..	4 %	4 %	104 —107	104 —107	106	..
494,096	Do. do. 4 % Pref. Stock	Stock	..	4 %	4 %	101 —104	101 —104	..	..
494,993	Do. do. Def. do.	Stock	..	4 %	4 %	107 —110	107 —110	..	..
1,330,000	City and South London Railway	Stock	1½%	2 %	3½%	71 — 73	70 — 72	71½	70½
85,090	Crompton & Co., Nos. 1 to 85,000	3	8 %	7½%	..	2 — 2½	2 — 2⅝	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	102 —106	101 —105 xd	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	2½%	Nil	..	0 — ¼	0 — ¼	..	..
17,189	Do. do. "A" shares, 01—017,189	5	2½%	Nil	..	1½ — 2½	1½ — 2½	..	..
344,028£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	73 — 77	71 — 75 xd	..	..
100,000£	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	75 — 80	75 — 80	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	1¾ — 2	1¾ — 2	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	..	..	..	2¾ — 3	2¾ — 3	..	..
82 500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	100 —103	100 —103	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¾ — 10¼	9¾ — 10 xd	..	..
200 000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	90 —102	90 —102	..	..
35,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	20 %	14 — 15	14 — 15	14½	14
35,000	Do. do. 4½ % Pref.	5	4½%	..	..	5 — 5¼	5 — 5¼	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	108 —112	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18¾ — 19⅝	18¾ — 19¼	18⅝	..
600,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	101½	..
87,500	†Liverpool Overhead Railway, Ord.	10	3½%	1½%	1½%	5¾ — 6	5¾ — 6	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10⅜ — 10¾	10¼ — 11	..	..
87,350	Telegraph Construction and Maintenance	12	17½%	20 %	20 %	32 — 35	33 36	33½	33½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	100 —103 xd	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3 %	3½%	99 —102	98 —101	98½	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

National Electric Free Wiring. ⅜—⅝.

Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 14¼—14¾.
Do. do. Pref. (£10 pd.), 10—10½.

Bank rate of discount 3 per cent. (June 18, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME.	Stock or Share.	Dividends for the last three years. 1900.	1901.	1902.	Closing Quotations June 24th.	Closing Quotations July 1st.	Business done week ended July 1st, 1903. Highest.	Lowest.
100,000	Blackheath and Greenwich Dist. Electric Light, Ord.	‡ 1	..	..	..	⅝ — ⅞	⅝ — ⅞	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs.	100	..	..	..	118 —121	118 —121	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000	5	6 %	8 %	8 %	10½ — 11	10½ — 11	11	..
20,000	Do. do. 7 % Cum. Pref.	5	..	..	..	10½ — 10⅝	10½ — 10⅝	..	..
50,000	Charing Cross and Strand Electricity Supply	5	9 %	10 %	10 %	9 — 9⅛	9 — 9⅛	9⅛	9⅛
70,000	Do. do. do. 4½% Cum. Pref.	5	..	..	..	5½ — 6	5½ — 6	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref.	5	..	..	..	4¾ — 5 xd	4¾ — 5 xd	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	104 —106	104 —106 xd	105¾	..
44,436	*Chelsea Electricity Supply, Ord.	5	5½%	4 %	4½%	6 — 6¼	6 — 6¼	..	..
150,000	Do. do. % Deb. Stock Red.	Stock	..	..	..	107 —110	107 —110	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595	10	0 %	5 %	5 %	11½ — 12¾	11¾ — 12¾	12	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	..	..	13 — 14	13 — 14	13⅝	..
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at 11⅝) all paid	‡	..	..	..	129 —128	131 —126 xd	121½	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	104 —107	102 —105 xd	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8⅞	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	..	..	..	12 — 13	12 — 13	12⅝	..
400,000	Do. do. 4½% Deb. Stock, Prov. Certs. (all paid) Red	..	..	..	..	111 —114	109 —113 xd	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	6½ — 7	6½ — 7	6⅛	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	6 — 6¼	6 — 6¼	6⅛	6⅛
140,000	Do. do. 4½% 1st Mort. Deb. Stock	100	..	..	..	108 —111	108 —111	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	12 %	10 %	10 %	11 — 12	11 — 12	..	..
90,000	Do. do. do. 4 % Debenture Stock	Stock	..	..	..	103 —106	103 —106	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	2 — 2½	2 — 2½	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5½ — 6	5½ — 6	5⅛	..
250,000	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	100 —102	100 —103	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 %	6¼%	7½%	17 — 18	17½ — 18½	17⅝	17⅛
220,000	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	108 —112 xd	..	..
250,000	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	98 —101	97 —100	97	..
10,852	Notting Hill Electric Lighting	10	7 %	6 %	6 %	13½ — 14½	13½ — 14½ xd	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15½ — 16½	15½ — 16½	16⅛	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8½ — 9½	8½ — 9½	..	..
150,000	Do. do. do. 5½% Deb. Stock Red	100	..	..	..	99 —102	98 —101 xd	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	..	2½%	3 — 3½	3 — 3½	..	..
65,000	South London Electricity Supply, Ord.	5	..	..	1½%	3½ — 4	3½ — 4	..	..
30,000	Urban Electric Supply, Ord.	5	..	..	..	5 — 5½	5 — 5½	..	..
30,000	Do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
110,000	Westminster Electric Supply, Ord.	5	10½%	10½%	12 %	12 — 13	12 — 13	12⅝	12⅜
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6½ — 6¾	6½ — 6¾xd	6½	..

*Subject to Founders Shares. ‡Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, July 1st.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/4	..
a	,, Nitric	per cwt.	22/-	..
a	,, Oxalic	per cwt.	32/-	..
a	,, Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal)	per ton	£33 10	..
a	,, ,,	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	,, (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£21	..
a	Lead, Nitrate	per ton	£24	..
a	,, White Sugar	per ton	£31	..
a	,, Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% at 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks	per lb.	3d.	..
a	,, Caustic (75/80%)	per ton	£24	..
a	,, Bisulphate	per ton	£35	..
a	Shellac	per cwt.	133/-	8s. inc.
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers	per ton	£6 5	..
a	,, Recovered	per ton	£5 10	..
a	,, Lump	per ton	£5	..
a	Soda, Caustic (white 70 %)	per ton	£10 15	..
a	,, Crystals	per ton	£3	..
a	,, Bichromate, casks	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots	per ton	£130	..
b	,, Wire, in ton lots	per ton	£168	..
b	,, Sheet, in ton lots	per ton	£166	..
p	Babbitt's metal ingots	per ton	£43 to £145	..
c	Brass (rolled metal 3" to 12") basis	per lb.	7½d.	..
c	,, Tube (brazed)	per lb.	9d.	..
c	,, ,, (solid drawn)	per lb.	7½d.	..
c	,, Wire, basis	per lb.	7½d.	..
c	Copper Tubes (brazed)	per lb.	9d.	..
c	,, ,, (solid drawn)	per lb.	9½d.	..
g	Copper Bars (best selected	per ton	£71	£4 dec.

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£71	..
g	,, Rod	per ton	£71	..
e	,, (Electrolytic) Bars	per ton	£67	..
e	,, ,, Sheets	per ton	£78	..
e	,, ,, Rod	per ton	£69	..
e	,, ,, H.C. Wire	per lb.	8¼d.	..
f	Ebonite Rod	per lb.	8/-	..
f	,, Sheet	per lb.	5/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	3/10 to 3/11½	inc.
i	Iron, Charcoal Sheets	per ton	£18	..
i	,, Pig (Cleveland warrants)	per ton	46/9	2d. inc.
i	,, Forgings, according to size	per ton	From £11	..
i	,, Scrap, heavy	per ton	47/6 to 50/-	..
i	,, Wire, galvanised No. 8	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 5	..
g	,, ,, Sheet	per ton	£13 10	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£3 12 6	..
d	Mica (in original cases) small	per lb.	4d. to 1/2	..
d	,, ,, ,, medium	per lb.	2/3 to 3/6	..
d	,, ,, ,, large	per lb.	3/9 to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	,, rolled bars & rods	per lb.	1/1 to 1/4	..
p	,, ,, strip & sheet	per lb.	From 1/2	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	10d. to 1/-	..
i	Stee., Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	,, ,, in bars		£15 to £40	..
g	Tin, Block	per ton	£128 10 to £129 10	10s. inc.
g	,, Foil	per lb.	1/8	..
n	,, Wire, Nos. 1 to 16	per lb.	1/7	..
p	White Anti-friction Metals—"White Ant" brand	per ton	£42 to £65	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	7¾d.	..
j	,, 6 lea. Flax	per lb.	6¾d.	..
j	,, 3 ply 10 lbs. Russian	per lb.	4¼d.	..
j	,, 10 lbs. Russian, single	per lb.	4¼d.	..
j	,, 180 lbs. Jute rove	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co.. Ltd.; *g* James & Shakespeare; *h* Edward Tuttle & Co.; *i* Bolling & Lowe; *j* W. H. Hindley & Co.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RECEIPTS.

	Locality.	Week ending	Receipts for the week. £	£*	Total to date. £	£*	Miles open.	*
	Aberdeen	June 27	1,247	— 48	4,864	+ 915	—	—
	Birmingham	,, 27	5,359	—520	130,056	+ 6,014	—	—
	Bournemouth	,, 24	952	—	—	—	—	—
	Blackburn	,, 26	909	—286	11,668	+ 674	12½	+1½
	Blackpool	,, 25	1,025	+ 27	16,268	+ 1,689	—	—
	Blackpool and Fleetwood	,, 27	684	— 262	10,235	+ 974	7½	—
	Bolton	,, 28	1,967	—582	24,881	+ 3,461	25	—
	Bradford	,, 28	4,011	—556	48 034	+ 5,144	39	+2
	Brighton	,, 21	869	+ 85	23,958	—	6½	—
	Bristol	,, 26	5,481	—388	—	—	28	—
	Burnley	,, 27	792	—141	—	—	—	—
B.E.T. Co.	Barnsley District	,, 19	161	—	4,247	—	—	—
B.E.T. Co.	Devonport	,, 19	435	— 2	10.182	+ 281	5	—
B.E.T. Co.	Dudley—Stourbridge	,, 19	795	+ 77	18,897	+ 2,074	18½	—
B.E.T. Co.	Gateshead	,, 19	806	+126	20 266	+ 3,892	10½	+ ½
B.E.T. Co.	Gravesend—Northfleet	,, 19	218	—	5,047	—	3½	—
B.E.T. Co.	Greenock—Pt. Glasgow	,, 19	607	+ 79	11,965	+ 1,301	7½	—
B.E.T. Co.	Hartlepool	,, 19	265	— 11	5,897	+ 584	6½	+2
B.E.T. Co.	Kidderminster	,, 19	145	+ 10	2.849	+ 211	4½	—
B.E.T. Co.	Merthyr	,, 19	195	— 7	4,637	— 174	8	—
B.E.T. Co.	Middleton	,, 19	290	+ 19	7,226	+ 696	8½	—
B.E.T. Co.	Oldham—Ashton	,, 19	504	— 36	18,556	+ 1,479	8	—
B.E.T. Co.	Peterborough	,, 19	122	—	3,047	—	—	—
B.E.T. Co.	Poole	,, 19	259	+ 9	6,556	+ 1,115	3½	—
B.E.T. Co.	Potteries	,, 19	1,421	— 72	37,214	+ 2,629	28½	—
B.E.T. Co.	Rothesay	,, 19	182	+ 62	1,968	+ 816	—	—
B.E.T. Co.	Sheerness	,, 17	67	—	949	—	—	—
B.E.T. Co.	Southport	,, 19	288	+ 16	6,741	+ 1,744	5½	—
B.E.T. Co.	South Staffordshire	June 19	828	+ 43	19,737	+ 1,241	21½	—½
B.E.T. Co.	Swansea	,, 19	463	+ 5	11,245	+ 916	5½	—
B.E.T. Co.	Taunton	,, 19	57	— 2	1,338	— 82	1½	+1½
B.E.T. Co.	Tynemouth	,, 19	298	+ 26	6,288	+ 942	5½	—
B.E.T. Co.	Weston-super-Mare	,, 17	101	— 26	1,516	— 142	2½	+2½
B.E.T. Co.	Wolverhampton Dist.	,, 19	349	+192	9.201	+ 5,289	10½	+8
B.E.T. Co.	Wrexham	,, 19	118	—	1,630	—	—	—
B.E.T. Co.	Yorks. Woollen Dist.	,, 19	293	—	4,748	—	6	—
	Cardiff	,, 27	2,060	—293	24,268	+ 9,136	—	—
	Dover	,, 27	268	— 27	5,066	+ 14	3	—
	Dublin	,, 26	5.161	—597	116,298	+ 5,951	46	—
	East Ham	,, 27	804	+ 116	8,520	+ 2,718	5	+ ½
	Glasgow	,, 6	15,376	+3194	15,376	+ 3,194	65	+18
	Hull	,, 27	1,862	—313	23,218	+ 1,885	—	—
	Ilkeston	,, 24	192	—	—	—	—	—
	Isle of Thanet	,, 27	882	—188	10,658	— 589	—	—
	Leeds	,, 27	6,028	—632	78,022	+ 5,712	—	—
	Liverpool	,, 20	2,669	— 90	242,553	+13,983	101	+5
	Manchester	,, 27	12,269	—	—	—	110	+85
	Newcastle	,, 27	4 325	+ 77	—	—	17	—
	Portsmouth	,, 27	2,341	950	—	—	29	—
	Salford	,, 29	4, 56	+ 637	47,129	+14,110	—	—
	Southampton	,, 25	1,045	— 93	—	—	—	—
	Sunderland	,, 28	1,405	—466	15,482	+ 542	20	+ 2
	Central London Railway	,, 27	7,059	—2982	181,585	+ 2,147	6	—
	Chatham & District Co.	,, 18	509	—	11,188	—	6½	—
	City and S. London Ry.	,, 28	2,444	— 486	79,2 6	+ 1.871	6½	—
	Dublin and Lucan Rlwy.	,, 21	127	+ 16	2,518	+ 81	—	—
	Liverpool Overhead Rv.	,, 28	1,080	— 80	41 177	+ 3 689	4½	—

* Compared with the corresponding period of 1902.

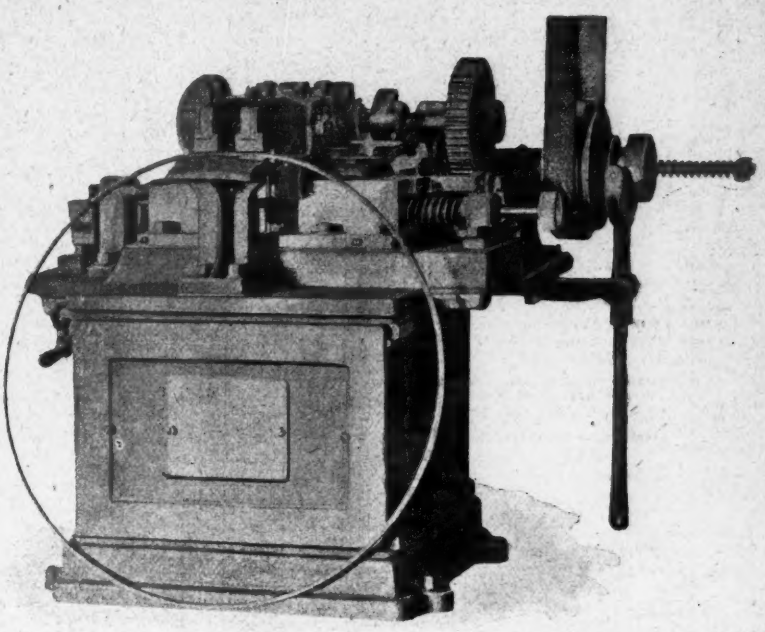
AUTOMATIC ELECTRIC WELDER FOR WIRE HOOPS, &c.

The following is a brief description of the automatic electric welding machine exhibited, for the first time in England, by Mr. Reginald J. Wallis-Jones, M.I.E.E., Assoc.M.Inst.C.E., at the Institution of Civil Engineers' Conversazione on June 17th and 18th.

The machine shown in the illustration consists of an alternating current transformer, the ends of the secondary being arranged to form the clamps into which the articles to be welded are placed; one clamp is stationary, while the other is free to move in the direction of the fixed clamp. By means of suitable mechanism, actuated by a separate motor or other convenient source of power, the machine is rendered automatic in all its operations, except that the pieces to be welded are placed in and taken out of the clamps by the operator. The apparatus is specially adapted, and largely used, for welding wire in the form of hoops, but can also be used for various kinds of work by slightly changing the clamping devices. The machine can be operated on an alternating current lighting circuit of 100 to 300 volts, or from a standard welding generator.

The method of operation is as follows:—The operator (usually a boy) stands before the machine, and places the two ends of the hoop between the clamps when they open. The clamps are then closed and the electric circuit completed. The metal at once heats at the joint, and when the welding heat is reached, the movable clamp slides towards the fixed clamp, pushing the ends together and effecting a weld. The primary circuit is then opened, the jaws open and the clamp slides back. All these movements are automatic. The welded hoop then being released, the operator throws it on one side and takes up another hoop, inserting it between the open jaws, and the operation is repeated. The machine can be speeded up to 11,000 cycles of operations per day, so it is obvious that if the operator succeeds in placing a hoop in the jaws every time they are opened, he makes 11,000 welds. It is found in practice, however, that this is beyond the ability of the operator, who is only able to introduce about 6,000 hoops per day of 10 hours; but the machine can be run at this high speed so as to hasten all movements. The speed may be reduced to 4,000, 6,000 or 8,000 cycles per day, if preferred. The wire is not cut off and straightened in the welding machine, but is prepared by cutting into lengths and rolling into the form of hoops.

The maximum welding capacity of the machine is 0·02 sq. in. cross-section of iron or steel, equal to No 8 S.W.G., and the maximum power required, when welding at this capacity, is approximately 3,000 watts. About $\frac{1}{10}$ H.P. is required to run the mechanical part.



Automatic Electric Welder.

THE "PERFECT CONTACT" SYSTEM FOR ELECTRIC TRACTION.

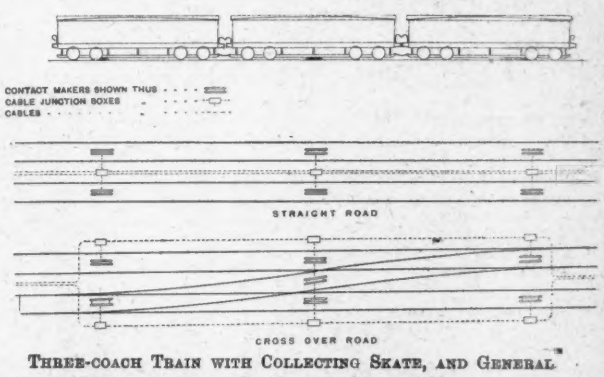
An improved method of supplying power for the purposes of electric traction on railways and tramways has been devised by Messrs. S. B. Cottrell (of the Liverpool Overhead Railway), W. H. Woodcock, and H. E. Walters, of 2, Great George Street, S.W. It is claimed that this system is also admirably adapted for the introduction of electric traction on existing railways, without unduly complicating the permanent way, or interfering with the steam locomotive traffic. In working out the details, the inherent objections to the overhead cable and the continuous live surface conductor have been kept in view, and it is claimed that where these objections have not been entirely overcome they have been very greatly reduced. The idea of separate contacts, continuously or intermittently alive, is of course as old as electric traction; the method of carrying it out, however, presents some interesting features.

The new system necessitates but little addition to the permanent way of existing railways, and presents no difficulties at points and crossings, junctions, level crossings, &c, nor does it interfere with the ordinary packing and maintenance of the permanent way. At the same time it obviates risk to platelayers and others working on, or crossing over, the railway.

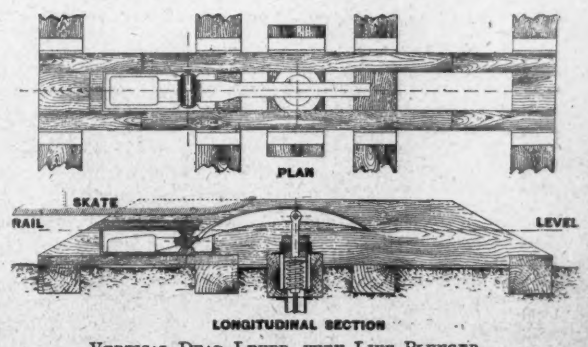
On this system the current for propelling the vehicles (which may be worked singly or coupled into trains) is supplied through feeder cables laid underground. At suitable distances lateral feeders are taken from the main cables and connected to contact makers, which are placed in the centre or at the sides of the tracks. Each contact maker is enclosed in a timber or other suitable frame, which can be spiked or bolted to the ordinary permanent way sleepers, and is provided with wooden guards. Each of the frames is fitted with one or more contact makers for delivering the current to collecting skates provided on the vehicles.

The skates collect current by rubbing on the surfaces of the contact makers, and are electrically connected throughout the length of the train; the contact makers are placed sufficiently near together to ensure that the skates shall always be collecting current from one or more of them so that the supply to the vehicle or train shall be continuous.

To ensure satisfactory passage of the skate over the contact maker, particularly when the former is running at high speed, special forms of contact makers and collecting skates have been designed, and provision has also been made that the varying height



Three-coach Train with Collecting Skate, and General Arrangement of Cables and Contact Makers.



Vertical Dead Lever, with Live Plunger.

of the skate, due to the action of the carriage springs, surging and side movement of the carriage itself, shall be accommodated. One of the methods devised for this purpose is illustrated herewith.

The skates are turned up at both ends in cases where they make vertical contact, and diminished in width at both ends in the cases

of horizontal contact; this allows of their easily entering upon and passing over the surfaces of the contact makers. They can also collect current when the vehicle or train is running in either direction.

The system can be combined with arrangements by which the supply of current to any section of a railway or tramway is placed under the control of the signalman in charge of such section. Where this is done and traffic is worked on the block system, the electric switch controlling the supply of current to any section is interlocked with the signals. The signals can only be lowered to safety after the current has been switched on to the section controlled by them; the vehicle or train can then enter and run over the section. After the train has passed over the section, the current must be cut off before the signals are placed at danger. It follows that each section is only alive during the time occupied between the lowering and raising of the signals. In the above case, should a driver run past a signal at danger, he immediately becomes aware of the fact by reason of not being able to obtain any current. To effect this it is necessary to supplement the continuous feeder conductor by section supply conductors, from which the lateral conductors are taken to the contact makers, the controlling switch making or breaking the junction of the section supply conductor with the main feeder conductor.

The following advantages are claimed for the system:—The length of exposed charged surfaces is reduced from 100 per cent., as in the case of continuous live conductors, to about 7 per cent. in the case of live contact makers. The complications which exist at points and crossings, when continuous exposed live conductors are employed, are entirely avoided. There is no interference with the maintenance of the permanent way or the packing of sleepers. The obstruction caused by snow or frost is reduced to a minimum. The failure of any one contact maker will not stop traffic. Greatly increased safety is assured for porters at stations and platelayers working on the track The contact makers are in all cases actuated by mechanical means. Economy is gained both in first cost and in maintenance.

THE LONDON CHAMBER OF COMMERCE.

At the annual meeting of the London Chamber of Commerce on the 25th ult., Lord Brassey, as President, pointed out the enormous amount of trade carried on by the United Kingdom, which occupies an area not larger than that of the State of New York. The aggregate of the imports and exports were valued at £900,000,000, to which he might have added a much larger total if he had included the internal trade.

He intimated that the Chambers of Commerce of the country were an important factor in influencing the Government of the day, because they reflected the trade of the nation.

At the present time two questions of the utmost consequence to the trading interests of the country are before the public, viz., the proposals for a revolutionary change with reference to our fiscal policy, and the rapid growth of trading by local authorities, and with it, of municipal indebtedness.

Much was said at the meeting of the London Chamber of Commerce about a forthcoming visit to Canada, and Lord Brassey was congratulated upon his skill in referring to the threatened fiscal changes as "skating over thin ice," by cleverly advocating the "open mind." Now, we ask seriously whether this is the right attitude for the Chambers of Commerce to adopt if they desire to influence public opinion one way or the other?

The Chambers of Commerce are constituted to promote all commercial interests, and no questions can be of greater consequence than those referred to, and upon which it seems that the "open mind" is a policy suggested.

Canada asks the question: "Are you prepared to impose differential duties in favour of your Colonies?" and the Chambers of Commerce are to reply, "Open mind," or, "We have no united opinion on the subject, and cannot attempt to influence our Government one way or the other."

At the annual meeting of the Association of Chambers of Commerce of the United Kingdom, held in London in March, 1902, the "open mind" policy was certainly not acted upon with respect to the "open door," for Lord Brassey moved, Sir Wm. Holland, M.P., seconded, and it was unanimously resolved:—"That his Majesty's Government be urged, in the interests of commerce, that, before recognising transference of territory by any power, they should insist on the adoption of the policy of the 'open door,' and should invite the co-operation of other States who are similarly interested with this country in maintaining existing rights."

This appears to us to be the proper attitude for our Chambers of Commerce, for they should utter no uncertain voice when dealing with questions of public policy affecting the trading interests of the country.

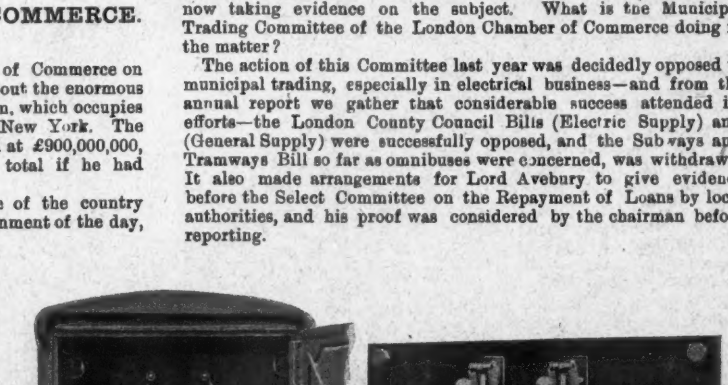
The Electrical Trades Section of the London Chamber of Commerce dealt with some important subjects last year, and exercised a beneficial influence upon the Government departments—one evidence of which is the Bill recently introduced by the Board of Trade for improvements in the Electric Lighting Acts. Among other subjects dealt with, were the regulations referring to high-pressure power schemes in connection with which the section issued a most valuable report upon the practice in France, Germany, Switzerland and America. The Board of Trade invited representatives from the electrical industry to confer with them upon the question, with the result, according to the annual report, that the department takes a more elastic view as to what is necessary for safeguarding the public interests with regard to high-pressure power schemes.

The section took vigorous action in opposing the attempt of the Postmaster-General to get clauses inserted in the Electric Tramway Bills, which would increase the liability of companies employing the overhead system. Deputations waited upon Lord Londonderry without any satisfactory result, but a subsequent appeal to the Chairman of Committees (Lord Morley) met with more success, and led to the Guard Wire Conference being convened by the Board of Trade, from which some good is expected. The Electrical Trades Section also took part in a conference with the Institution of Electrical Engineers on the Factory and Workshop Act of 1901, which especially considered the regulations with reference to the employment of youths as switchboard attendants.

Thus the trade sections do good work for their respective industries, and the Chamber is also useful in dealing with such a supremely important question as that of the improvement of the Port of London, to which subject the Chamber of Commerce has devoted considerable attention, its "scheme for a London Port and Harbour Trust" being practically adopted by the Royal Commission on the Port of London, whose report was issued in June last year. The example of Liverpool and other towns is recommended in the formation of a single port authority; but it is by no means an easy problem to constitute such a body for London, with all the complications that exist, and the multitude of conflicting interests that have to be reconciled.

No mention was made at the annual meeting of the Chamber, of the municipal trading question, which was remarkable in face of the reconstitution of the Joint Committee of the Houses of Parliament, now taking evidence on the subject. What is the Municipal Trading Committee of the London Chamber of Commerce doing in the matter?

The action of this Committee last year was decidedly opposed to municipal trading, especially in electrical business—and from the annual report we gather that considerable success attended its efforts—the London County Council Bills (Electric Supply) and (General Supply) were successfully opposed, and the Subways and Tramways Bill so far as omnibuses were concerned, was withdrawn. It also made arrangements for Lord Avebury to give evidence before the Select Committee on the Repayment of Loans by local authorities, and his proof was considered by the chairman before reporting.



L.C.C. Tramway Feeder Switch Pillar.

The Municipal Trading Committee of the London Chamber of Commerce brought under the notice of the ratepayers throughout the country the wisdom of opposing the Socialistic movement, and we think that some further evidence should be tendered to the new committee in support of the same views.

L.C.C. TRAMWAY FEEDER PILLAR.

The illustrations above show the arrangement of the switches and the interior of the switch pillars supplied for the South London Electric Tramways by the British Insulated and Helsby Cables Co.,

Ltd., to the designs of Mr. J. H. Rider, electrical engineer to the L.C.C. Tramways. A diagram of the connections of the switches was given in our article, Vol. 52, p. 832, showing how the four different methods of coupling up the feeders, or cutting them out, by means of the links on the back of the board are effected. The switches connect directly with the eight ends of the conductor rails at the section insulator opposite the switch pillar. Both poles, positive and negative, are controlled in the pillar, the return being insulated from the earth.

THE ENGINEERING CONFERENCE.

THE MODERN EQUIPMENT OF DOCKS, WITH SPECIAL REFERENCE TO HYDRAULIC AND ELECTRIC APPLIANCES.

A PAPER, by Mr. Walter Fitt, M.Inst.C.E., with the above title, was read at the Engineering Conference of the Institution of Civil Engineers on the 19th inst., Sir Leader Williams in the chair. The line taken in the paper was that notwithstanding the reliability and easy manipulation of a hydraulic system for the transmission and distribution of power for docks, an electric system was to be preferred, because everything that could be done by hydraulic transmission could be done by electric transmission, and a great deal more besides, and at a cheaper rate. There was not much difference in the first cost of an electric or hydraulic crane installation, but in the connecting link between power house and cranes, there was an immense advantage on the side of the electric mains as compared with the cost of hydraulic mains. The docks at Hamburg, Rotterdam, Genoa, Bremen and Naples, were given as instances where electric appliances about docks had replaced hydraulic. Comparative tests by Mr. Baxter, the mechanical engineer of the Clyde Navigation, on a 3 to 5-ton compound hydraulic crane, and a 3-ton electric crane at Glasgow were quoted, showing that at all loads, except full load, the efficiency of the electric crane was much greater. At full load the hydraulic had a slight advantage in efficiency. Tests given by Mr. Phillip Dawson, A.M.I.C.E., in *Traction and Transmission* for May, were also quoted, confirming the conclusion that the hydraulic-power consumption varied approximately between one and three times that of the electric crane per cycle of operations. The extreme flexibility of electric transmission, and the ease with which extensions could be carried out, were further points that would carry the day in favour of electric power, even if the cost of working were somewhat more instead of less than hydraulic.

Mr. ELLINGTON criticised the test figures quoted in the paper. The net work done in both the hydraulic and electric cranes was given in watt-hours, but no mention was made of the speed at which the cycle of operations was performed. The efficiency of an electric system, where the demand for power was made directly on the generating plant, was much less than was possible with a hydraulic system in which an accumulator was used. Where you had to supply power to a considerable distance, however, say, to a crane, it might be advantageous to use electric transmission up to that point.

Mr. PITT: Do you mean you would have both systems, electric and hydraulic?

Mr. ELLINGTON: Yes, under those circumstances.

Mr HUMPHREY pointed out that the value of an hydraulic system in extinguishing fires should not be lost sight of. The author had mentioned the Rotterdam Docks. The engineer of these docks had told him that the cost of their electric coal hoists and cranes exceeded that of hydraulic machines, but "it suits us." He understood that there were 138 electric cranes at Rotterdam, three only of which at that time were in use, and he considered in any comparisons made that the time machines were laid by for repairs or want of user should be taken into account. Hydraulic transmission and appliances were absolutely reliable and under control. Damp gave rise to continual difficulties with electrical plant. At Amsterdam, after seeing the Rotterdam installation, they had decided that two new coal hoists about to be put down should be hydraulic.

Mr. DOBSON said that the hydraulic installation put down at Buenos Ayres by Sir William Armstrong & Co. worked absolutely perfectly. There were, however, certain troubles experienced; firstly, the losses due to varying loads. From the nature of the merchandise dealt with, the loads on their cranes varied considerably, and a continual loss was going on; secondly, there was the loss in mains, which were laid, in their case, over a distance of 9½ miles; and thirdly, there was considerable wear of valves owing to fine sand being present in the waters of the River Plate. He had looked into the question of making their extensions on the electric system, but had concluded it would be too costly, and had therefore continued with hydraulic.

Mr. CECIL BROWNE had recently looked into the matter of the most suitable system for a new up-to-date dock scheme now in a Bill before Parliament (the speaker subsequently gave the name of the Docks as for Maryport Harbour). He had come to the conclusion that an electric system was the best in every respect. The North-Eastern Railway Co. had given him facilities for investigating the working of their electric cranes at Middlesbrough Docks, and he had found the system there very efficient and reliable. There was frequently a great deal of trouble from joints experienced with hydraulic mains laid in made ground. In an electric installation you effected economy by having one generating station and one staff for the whole of the power distribution and lighting.

Mr. STOKES gave the cost of hydraulic power as 2d. for production and 1d. for transmission, per H.P.-hour, and 1½d. for production and rather over ¾d for transmission by electric power, including 4 per cent. interest and all maintenance charges. The fact that you could overload an electric plant he thought was nearly if not quite of equivalent value to the hydraulic accumulator. He considered the electric system to be the more economical and equally reliable system of the two.

Prof. JAMIESON had made observations with pressure gauges at different parts of an hydraulic system, and had found practically no loss between the source of supply and the hydrant adjoining the crane, but between this latter and the crane ram he had been most astonished to find great loss of pressure. On a 3-ton crane there was a pressure of 560 lbs. at the ram, and 750 lbs. at the hydrant, when lifting 3 tons, but when lifting 2 tons, the pressure in the cylinder fell to 400 lbs., that at the hydrant remaining the same. When you had this large number of "wee pipies" all over the place, a great deal of your useful pressure was lost. When cranes near the source of supply were at work the pressure was greatly reduced on the distant machines. He understood now, that a 7-in. main had been put in to obviate loss of pressure in this particular dock.

Another speaker said that the adoption of one or other system was purely a question of conditions. If the load were variable electricity was by far the best; but if he were dealing with a constant load he would put in hydraulic power.

The author, in his reply, stated that no arguments had been advanced by speakers that at all influenced his conclusions as given in the paper in favour of electric power for docks. Speakers had appeared to betray a considerable amount of doubt as to the reliability of electric working, but he assured them that an electric installation was perfectly reliable and the motors were absolutely under control. Even in an electric system, should it be desired to work one or two coal hoists hydraulically, what was there to prevent a motor being put down to pump up an accumulator for that particular purpose? He was quite convinced on the point of cost. There could not possibly be so much loss going on in the single reduction gear or even in a double reduction gear of an electric motor as in the numberless pulleys and chains in an hydraulic crane. From tests on an electric crane at his works the actual ascertained figures were 79·3 per cent. efficiency at full load from motors to load, whereas the highest attainable in hydraulic transmission was 66 per cent. Added to that you had to have very large mains in an hydraulic system to keep the pressure constant. He believed 11 in. pipes were used in the London supply. You could get your electric current at 2½d. per unit from supply companies, or possibly even less from a Corporation (at the expense of the ratepayers), or you could make it yourself at 1½d. per unit. He certainly disagreed that the two systems together involving two separate staffs could be of any advantage over one system for lighting and power. You must have electric plant for lighting, and economy lay in one set of boilers and engines and one system.

Sir LEADER WILLIAMS, in concluding, said the hydraulic system applied to move the swing bridges and locks in the Manchester Ship Canal had proved absolutely satisfactory, and this notwithstanding the great length of piping required. But they had also electric power for lighting and for the working of small cranes for unloading and loading, and he fully recognised the advantages of electric working for these purposes. There was no doubt it was exceedingly useful as a system for combined lighting and power, and also on account of its extreme flexibility.

OVERHEAD AND OTHER RAILWAYS.

IT is quite possible that, through untoward circumstances, there are dwellers in back streets to whom their surroundings are fully as distasteful as they would be to Mr. S. B. Cottrell or ourselves, or other more fortunately placed mortals. They may even possess the same longing as any of us for a river-side villa with a boat house and lawns to the river edge. To such Mr. Cottrell's paper on "Overhead Railways" will not appeal sympathetically, for he advocates, as a solution of urban railway traffic, overhead railways of the hideous American type, if they can be constructed in back streets, where compensation would be immaterial and their unsightly appearance would not be objectionable.

This is, to say the least, scarcely humane. Moreover, it is unwise to condemn even back-streeters to the horrors of a hammering overhead racket.

A second recommendation is the shallow subway where it can be constructed. London had the chance of this system between St. James's and Holborn in 1889, but Mr. Woodall's Committee threw out the Bill. The scheme, as proposed, would have put a stop to all future tearing up of the streets.

A third proposal is deep-level railways. In each case electricity is proposed as the motive power. The author looks on the shallowness of the old underground railways as a valuable asset. Undoubtedly this is so, but there is too little shallowness, and far too many stairs. A really shallow line would not be half the depth of the Metropolitan.

It is certain that really shallow lines alone will take short-distance passengers off the surface. They alone are self-ventilating. The self-ventilating power of a shallow subway railway must be evident to anyone who considers for a moment how the air of the Underground continues to support life in spite of the smoke of the many furnaces of locomotives. With electric motive power there would be no ventilation problem except for deep tubes.

The existing system of overhead railway on brick viaducts is bad enough, but the overhead railway of the American type, and, we believe, Mr. Cotterell's type, is an iron gantry carried noisily up the middle of the street, often within a few feet of third floor windows. If overhead railways were necessary, it were better to run them up the widest streets possible.

The paper gave rise to a very considerable discussion, chiefly in that inaudible manner which is, we think, becoming more marked at every meeting. One gentleman who spoke from the platform with great hesitation, was quite inaudible.

Mr. B. H. Thwaite advocated the *platforme roulant* of the late Paris Exhibition, and exhibited some albums of fine photographs of this system, in which there is probably much more than many imagine, for the platforms never lose energy by braking and are not extraordinarily hard to move and keep going.

Mr. Cuningham, of the Central London Railway, objected to shallow subways, and did not hesitate to ask the meeting to consider that it was as difficult to ventilate a shallow subway as a deep tube. He appeared to base his argument on the fact that the "Underground" atmosphere contains as much carbonic acid as the Twopenny Tube! What about the coal-fired locomotives of the Underground? However, though this argument was put forward, we saw no one who looked equal to absorbing it.

A gentleman, who evidently believed with the majority that the Tube ventilation was bad, drew attention to the large movement of of air in the Tube, and suggested, very sensibly, that by proper trapping this movement could be made to effect changes of the atmosphere. Such a system of trapping could readily be carried out. The vile condition of tube atmosphere was pointed out in the technical Press as sure to arrive long before the Twopenny Tube was made, and soon after the South London line had demonstrated the bad ventilation, but no steps were taken to remedy the defect before it arose, as might have been easily done.

The whole tube railway question has been muddled from the first, and as these lines multiply, it is to be feared there will arise many difficulties at points where tubes cross each other.

The shallow subway system appeared to frighten people because of the trouble with pipes, but it cannot be agreed that the time of descending a few steps to the trains can be compared with the time taken on deep tubes. Deep tube advocates always talk as though the lifts landed passengers at the train platform, whereas, in fact, they land them scores of feet away and demand of them often several feet more of steps than would be called for by any shallow system.

GAS STANDARDS AND SMOKE ABATEMENT.

Mr. G. T. Beilby evidently builds his hopes for smoke abatement on the displacement of coal by gas. This is not a particularly scientific solution of the problem, save and except for domestic purposes, the domestic fire being so hopeless in regard to smoke. To get over the difficulty he advocates a tax on all but very small chimneys, as this would compel the use of coke and of anthracite. We think the domestic solution is far more likely to come in the way of cheap gas. How does the author expect to compel everyone to burn coke or anthracite or even gas, until this is supplied very much cheaper than at present? The price of coke would become prohibitive if a large demand were made for its supply.

The discussion on this paper was most feeble and ineffective, and nothing of any serious value was put forward. One gentleman, however, created some amusement by his objections to admitting carbonic oxide gas into his house. He did not wish to go home and find his wife and other relations lying dead about the house. This is a danger, of course, to which carbonic oxide gas may expose users. He would not object to his business rivals using it. Smoke abatement discussions seem to have degenerated into merest platitude, and the eternal round of apparatus is discussed as though a chemical process could be carried out by apparatus when the essential qualification of necessary temperature is not only carefully ignored, but sedulously destroyed. Some one ought to have got up and shouted—Temperature!

The paper which followed that on smoke in the same section dealt with standards of illumination as applied to gas, and was interesting as an example of the fact that it requires 10 years to bring an idea to fructification, for we are reminded that the modern craze for gas on a calorific standard was started in 1892 by Mr. B. H. Thwaite in his paper on fuel and power gas in Birmingham. Mr. Thwaite then called for gas of 10 to 12 C.P. supplied at a pressure of 4 in. to 16 in. To-day these figures are accepted as the proper solution of the question of gas illumination by calorific incandescence.

The discussion on this paper merely served to point out that gas engineers appear to have no idea of what a chimney is, or they would endeavour to provide all their gas lights with pipes or flues leading to chimneys in communication with the outer air. However, if they do not realise that sulphurous gas products might thus escape from dwelling rooms and promote ventilation in doing so, perhaps it is not for electricians to teach them.

STEAM TURBINES.

It is generally forgotten that the possibilities of the steam turbine were indicated by Tournaire, a French engineer, as far back as 1853. Prof. Rateau now tells us that the design of a steam turbine is an easy matter to one possessed of a knowledge of the thermo-dynamic properties of steam, and a thorough knowledge of the principles of the hydraulic turbine; but one must also know the practical coefficients to employ. In this, certainly, the turbine differs from piston engines. Expansion can be pushed further, and more perfect vacua made of good use. Conversely the turbine is not economical when exhausting to atmospheric pressure.

The author points out the differences between pressure and reaction turbines, the former being liable to lose in efficiency if not protected from internal leakage losses, and demanding uniform distribution of pressure, whereas the latter have no leakage troubles and can receive the working fluid on a portion only of their circumference. There are, however, we might add, compound reaction turbines in contemplation, if not constructed, besides that of the author, who, by the way, does not seem correctly to state the relation of speed between the reaction and the action turbine. Surely it is the latter, or De Laval type, which runs at the higher speed of rotation.

The author is prepared to apply his turbo-pumps to lift water several hundred metres and to compress air to six atmospheres.

PETROL MOTORS FOR LOCOMOTION.

Mr. E. Sauvage discussed petrol motors in a paper which simply recapitulated a few of the salient features of these machines. He would like further data as to cost of transport by petrol motors, their present use rather embodying the idea of an advertisement than of a striving after economy. In respect of heavy traffic it seems to us more probable that steam power will supersede petrol, and the steam will be raised by liquid fuel of the heavy type, such as tar or Texas oil burned by atomising methods. When vehicles without horses are as common as those with them, the advertisement inducement to use petrol will have disappeared, and commercial considerations will obtain sway. To-day everything points to steam as the motive power for heavy cars. Petrol may remain for light cars, if not displaced by the coming electric accumulator.

The author seems to favour combination frames of wood and iron of considerable length with small wheels placed far apart. Circulating the pumps in series with the motor, radiator and tank, are a necessity. Fans are useful to help the draught through radiating coil. Numerous cylinders promote steadiness, but introduce complication. Recent construction appears to favour mechanical operation of both inlet and exhaust valves.

GAUGES AND STANDARDS.

Mr. H. T. Marshall's paper on "Gauges and Standards in Shop Administration" is a paper that ought to be read by young engineers before entering on the profession as such. It is a good and useful paper, dealing with a system of shop organisation; but, what is perfectly proper, it shows clearly that the business of the manufacturing engineer is very different from that pictured by the beginner, who usually thinks only of the engineering side. This paper shows up the sordid side of manufacturing, the money-making part of the business, which simply aims to make so many things at a minimum of cost. The engineering part of a manufacturing engineer's business is not merely reduced to a minimum, but it is apt to be discarded altogether, and until within recent years too many of our old-established shops discarded even the mechanic. The mechanic has been reinstated and allowed to spread his talents over the productive output of machine tools, and great changes have been wrought. The engineer is still kept back too much it may be, but it must be borne in mind that engineering is distinct from the work of the high-class mechanic, and that this, again, is distinct from the manufacturing side. If young men would grasp the signification which attaches to manufacturing processes as distinct from design they would be less disappointed at the sordid element which they are bound sooner or later to encounter. At the same time, half the design of a machine should include the knowledge of how the manufacture of any machine is to be carried out in harmony with the sordid department. The object of all engineering is to make money, though it is less apparent in some cases than in others. In a paper like the one named one comes closely into contact with the aim of a machine shop, which is to produce articles at a minimum of cost and of a maximum of good quality.

The references of the paper to the limit gauge system had a bearing on this latter, but we did not think the various speakers had grasped the principles which underlie the system of limit gauges. These gauges are simply a recognition of the fallibility of tools and workmen, and of the fact that the more nearly one works to exact sizes, the more expensive the work becomes Recognising the impossibility of absolute accuracy, the limit-gauge system simply sets bounds to the inaccuracy, and allows all work within such bounds to pass muster. Major Sankey appeared to get quite adrift on the subject, and spoke about what was to be done with costly pieces which failed to pass the limit test. Obviously, if product is to be maintained high class, such pieces must be rejected, and it then devolves upon some higher authority than the viewer to say if such rejected piece is to be scrapped, or if it is capable of being repaired. But this very instance is really an argument for the system, and not against it. It was also suggested that with possible various fit differences and fits—running, fast or keying, and sliding or push fits, there would be a multiplicity of gauges which

might become useless. There is, of course, this objection to a solid limit gauge, but limit gauges need not be solid, unless for very special standard work.

The Newall system of limit gauges provides adjustable gauges and a very simple means of accurate adjustment. With these adjustable gauges, shop work can be carried out better and cheaper than by fussing with standard gauges and thin paper differences.

Of course, the limit-gauge system is most particularly applicable to turned and bored articles. As regards the objection to the expense of large gauges, it can be said that, in a good shop, as sizes increase, so do the steps from size to size; there are very few large gauges needed, and these on the adjustable system can be still further reduced in number. Thus, where there may be scores of pins from 1 in. to 4 in. on a large set of marine engines, there is but one main shaft bearing. Nor are limit gauges intended for the odd large size. They are for producing the many small parts on which time saved may be a large percentage of cost. The time saved on a large shaft would be relatively a small item, for the turner would set his callipers while work was going on, or would use some fixed gauge. The raising of such questions is an indication that the principles of the limit gauge are not rightly grasped.

THE POSITION AND PROTECTION OF THE THIRD RAIL ON ELECTRIC RAILWAYS.

By William E. Langdon.

(*Abstract.*)

There is ample evidence that we have now arrived at a period when surface lines of railway—lines of ordinary construction for steam haulage—have to be considered in relation to their operation by electrical agency. Tube lines will, no doubt, where they have means for doing so, form connection with near surface lines for the purpose of ready interchange of traffic. And when it is understood that all of the main lines are considering the propriety of electrically working portions of their systems, the question of arriving at a decision as to the position of the conductor rail, is, in the interest of all, most desirable. In any case, the residential lines will avail themselves of the advantages to be obtained from electric traction; and a recognised standard will become an absolute necessity.

Conductor Rail.—There appears to be no uniformity in the position of the conductor or third rail.

The practice with the earlier lines operated by electricity has been to lay the third rail between the wheel rails, and to employ the wheel rails, duly bonded, to form the return conductor. For the Mersey tunnel, the Metropolitan District, Metropolitan, and other electrical lines, in contemplation or under construction, an insulated rail is used for the "return." The potential conductor is placed at a given distance outside the wheel rails, and the return rail between them. It is considered that this practice, viz, the provision of an insulated, or, at all events, of an independent return rail will be found in future constructions. The object in thus employing conductors independent of the wheel metals is that it avoids any interference therewith, and ensures, as far as possible, perfect continuity. It will also be helpful in preventing trouble with the telegraph service.

In all instances the conductors are, whether insulated or not, laid upon the sleepers which serve the wheel rails, and this appears to be the practice in America as well as here; but in the States, where the sleepers employed are not so long as those used in this country, every fifth one, or thereabout, is made longer for the purpose of providing for the support for the third rail.

Protection of Conductor Rail.—There is, of course, no absolute necessity for the protection of the return conductor; but for the third rail, viz, that which forms the potential conductor, protection is desirable, and has in some instances been provided. This protection usually consists of a vertically-arranged plank on one or both sides of the rail, the upper edge of the plank being somewhat higher than the top surface of the rail, so that anything falling across it may not form contact with the conductor.

It is suggested that this affords no protection from weather, and but an imperfect protection against accidental contact. The conditions that will attend surface-lines are very different from those which apply to tube-lines, or lines which are not open to trespassers. Climatic conditions will be found to be far more troublesome. Snow, rain, and fog are enemies which have little, if any, effect upon a covered line. It would, therefore, appear desirable that the most complete protection of the conductor-rail, both with respect to climatic effect and accidental or intentional interference, should be provided for. This may be better obtained by adopting a roof cover, extending so far beyond a vertical line drawn from the edge of the rail as would prevent a person standing against it, or an implement placed against it, from touching the conductor.

Points for Consideration.—Two important questions present themselves, viz:—(1) The distance which should supervene between the near wheel-rail and the conductor, or between the latter and the return rail; and (2) whether the sleepers which carry the wheel-rails should be used for the conductor rails.

It is probable that the first of these two important questions will only be determined after experience of the climatic effects to which they will be exposed has been obtained. With respect to the second question, however, the subject can at once be considered.

In considering it we have to bear in mind:—(*a*) That the permanent way must be constantly patrolled; (*b*) that packing and drainage of the sleepers are essentially an everyday occurrence; (*c*) that renewals of sleepers and rails, replacement of defective sleepers, broken chairs, &c., must be provided for; (*d*) that when laying out stores for any of these works the off-side of the line is almost invariably used; (*e*) that the off-side of the line is also used by workmen and others when walking the line.

All these conditions, it is thought, suggest the propriety of confining the conductor-rails to the "six-foot," and dissociating them entirely from the sleepers which carry the wheel-rails. This would, inasmuch as structures would at points narrow the space, and for other reasons, necessitate the use of a flexible collector, which ought not, however, to prove an insurmountable obstacle.

It would also entail, where a fourth rail is employed, the provision in the 6-ft. space of a structure which would accommodate both the potential and the return-rail.

It would also claim consideration in dealing with crossings. With a multiple-unit train no trouble would arise, but with a train worked by a locomotive it would be necessary to supplement the *collectors* on the locomotive by *collectors* on the next vehicle, which would ordinarily be the guard's van or brake.

The following Table gives the location of the positive collector-rail where electric traction has already been installed:—

Name of railway.	From top of positive rail to top of track rail.	From track gauge-line to centre of positive rail.
Main Line Railways Electric and Steam Service.	Inches.	Inches.
Baltimore and Ohio Railroad, Baltimore, Maryland (old location)	1¾	24
Baltimore and Ohio Railroad, Baltimore, Maryland (new location)	3½	30
Albany and Hudson Railroad, New York...	6	27
New York, New Haven and Hartford Railroad, Connecticut	1½	Centre.
Paris-Orleans Railway, France	7⅞	25⅝
Gallarate, Italy	7½	26⅝
Mersey Railway, Liverpool	4½	22
North-Eastern Railway, Newcastle ...	—	—
Lancashire and Yorkshire Ry., Liverpool...	—	—
Inter-Urban Railways. Electric Service only.		
Aurora, Elgin and Chicago, Illinois ...	5 5/16	20½
Columbus, Buck. Lake and Newark, Ohio...	6	27
Columbus, London and Springfield, Ohio...	6	27
Lackawanna and Wyoming Valley, Pennsylvania	6	20½
Grand Haven, Grand Rapids and Muskegon, Michigan	6	20⅝
Elevated and Underground Electric Railways		
Metropolitan West Side Elevated Railway of Chicago, Illinois	6¼	20½
Lake Street Elevated, Chicago, Illinois ...	6½	20⅝
South Side Elevated Railway, Chicago, Illinois	6¾	20½
North Western Elevated Railway, Chicago, Illinois	6½	20⅝
Brooklyn Elevated Railway, Brooklyn, New York	6	22
King's County Elevated Railway, Brooklyn, New York	5¼	19½
Manhattan Railway, New York	7½	20¾
Rapid Transit Subway, New York... ...	4½	22
Central London Railway, London... ...	1½	Centre.
Liverpool Overhead Railway	1½	Centre.

It will be noted that there is a wide variation in the dimensions but in general, the main line steam railways of America and the Continent, have found it necessary to place the rail at a greater distance than 24 in from the gauge line. This is due to the width of steam locomotives and heavy goods cars, and to the specially long and low double-bogie stock for transporting bulky apparatus and machinery, such as car bodies, fly-wheels, generator frames, &c.

THE FIFTH INTERNATIONAL CONGRESS FOR APPLIED CHEMISTRY, BERLIN, JUNE, 1903.

[Report of the Proceedings of Section X. (Physical Chemistry and Electro-Chemistry), by our Special Correspondent.]

(*Concluded from Vol.* 52, *page* 1065.)

Friday, June 5th.—*Morning Session.*

The Friday morning session of the Congress was reserved for the second general meeting of all the members, and the Assembly Hall of the Reichstag was crowded to hear the

lectures by Prof. Moissan, Sir William Crookes and others on subjects upon which they have become the leading authorities in Europe. Only two of the six addresses delivered on this occasion had any special interest for electricians, and therefore demand notice in this report.

Sir William Crookes had chosen as his subject "Modern Views on Matter: The Realisation of a Dream," and had wisely arranged for the address to be distributed in printed form to every member of his audience.

The address dealt with the recent discoveries in the realm of molecular and atomic physics, and especially with the work of Monsieur and Madame Curie in connection with radium. The old theories of the constitution of matter demand revision in the light of these discoveries; and, in Sir William Crookes' opinion, the "electron" theory is, for a time, at least, likely to supersede the Dalton atomic theory, and others based upon it, in explanation of the chemical and physical properties of matter. Sir William Crookes read his address slowly and distinctly in English, and the applause with which it was greeted, showed that most of his audience had benefited by their printed copies, and had been able to follow and understand it.

The subject chosen by Prof. Van't Hoff was the "Formation of Natural Salt Deposits," and the address dealt with the results obtained in recent work of the author relating to the crystallisation of salt mixtures.

By the use of graphic methods of presenting the results, and of the "Phasen-lehre," the author has been able to calculate the composition of the crystalline mass that will separate on concentrating any mixture of salt solutions. The subject was somewhat too technical for a general audience, and the address would, no doubt, have been followed with more attention if printed copies of it had been placed in the hands of the members.

FRIDAY, JUNE 5TH.—*Afternoon Session of Section X.*

The sectional meetings were resumed on the afternoon of Friday, and the following papers and reports were read and discussed in Section X:—

1. "Electro-chemical units," by Prof. Nernst (Göttingen).

2. "Report of the Commission upon Electro-chemical and Physical Units, appointed at the Paris (1900) Congress," by Prof. Marie (Paris).

These two papers were discussed together, and after remarks and criticisms from Profs. Noyes, Nernst and Kohlrausch, and from Dr. Böttinger, it was resolved that the proposal of the *Deutsche Bunsen Gesellschaft* to recommend the general adoption of the symbols and expressions for physical units—printed on p. 1063 of this report—be accepted and supported by the members of Section X.

3. "The Decomposition of Carbon Monoxide," by Dr. Schenck, Marburg. Discussion—Drs. Bodenstein and Bodländer.

4. "Variations in the Electrical Resistance of Bodies other than Selenium, under the Influence of Light," by M. Arcel, Paris. No discussion.

5. "The theory of the Contact-process for Sulphuric Acid Manufacture," by Dr. Bodenstein, Leipzig, and Prof. Bodländer, Braunschweig.

6. "Chemical Reactions at High Temperatures and their Industrial Use," by Prof. Zengelis, Athens. No discussion.

SATURDAY, JUNE 6TH.—*Morning Session.*

The following papers were read at the morning session of Section X., on Saturday, June 6th, Prof. Van't Hoff acting as chairman for this meeting of the section.

1. "A Gravity Formula applicable to Diffusion Phenomena," by E. Solway, Brussels. Discussed by Profs. Bredig and Van't Hoff.

2. "Study of the Theory of Reduction Phenomena," by Prof. Goldschmidt, Christiania. Discussed by Drs. Arndt and Seckur, and by Profs. Elbs and Van't Hoff.

3. "The Applications of Electrolysis in the Preparation of Organic Compounds," by Prof. Elbs, Giessen, and Dr. Buchner, Mannheim. Discussed by Dr. Kahn.

4. "The Technical Applications of Catalytic Action," Prof. Bodländer, Braunschweig. Discussed by Profs. Le Blanc, Bredig and Goldschmidt and by Drs. Arndt and Bodenstein.

5. "The Formation of Complex Compounds by the Sulpho-cyanide Ion," by Dr. Grossmann, Münster. Discussed by Profs. Bodländer and Abegg.

The afternoon session of Section X. on Saturday, June 6th, was held under the presidency of Prof. Lunge, Zürich, and the following papers were read and discussed:—

1. "Electrical Endosmose and the Colloidal State," by Prof. Bredig, Heidelberg, and Dr. Graf Schwerin, Höchst. Discussed by Profs. Lunge, Nernst, Coehn and Le Blanc, and by Drs. Arndt, Suchy and Müller von Berneck.

The adjourned discussion upon the papers read by Dr. Schenck and by Drs. Bodenstein and Bodländer at the afternoon session of Friday was resumed, and the following took part:—Profs. Nernst, Coehn, Meyerhoffer, Bredig and Tamann, and Dr. Wöhler. Two further papers were then read:—

2. "The Physical Chemistry of Wine," by Prof. Magnanini, Modena. No discussion.

3. "Hydrogenation by Catalytic Action," by Prof. Sabatier, Toulouse. No discussion.

The final meeting of Section X. was held on Monday morning, June 8th; and previous to this meeting the members still remaining in Berlin were photographed in a group, on the steps of the main entrance of the Reichstag building. The meeting of Monday was presided over by Prof. Lepsius, of Griesheim, and of the 13 papers put down in the "Congress Tageblatt" for this session of Section X., the following were read:—

1. "Experiments with Metallic Diaphragms," by Prof. Bancroft, Ithaca.

2. "Research Work in Physical Chemistry in America since 1900," by Prof. Bancroft, Ithaca, and Prof. Noyes, Boston.

3. "Concentration of Solutions by Freezing, and the Production of Low Temperatures," by Dr. Monti, Turin.

4. "Colloidal Substances," by O. S. Burns, Boston.

5. "The Design and Erection of 'Galvanischen Austallten,'" by Dr. Sackur, Berlin.

6. "The Electrolytic Production of Soda," by P. Heroult, Paris.

7. "The Quantitative Separation of Metals by Electrolysis," by Dr. Danneel, Aachen.

Monday afternoon was devoted to the final general meeting of the Congress, and as already announced in our columns, the invitation to hold the next Congress in Rome was accepted by a majority of 20 votes, the alternative proposal being to meet in London.

In concluding this report of the proceedings of Section X. of the Fifth International Congress for Applied Chemistry, the writer may with advantage draw attention to two points, in which the organisation of the sectional proceedings of the Congress demands improvement.

In the first place, only four of the 48 papers planned for reading before Section X. were printed and placed in the hands of the members, and practically the same proportion ruled in other sections. As a consequence of this arrangement, nearly every paper presented was read by the author from manuscript in *extenso*, with a total disregard of the time occupied in reading. At future Congresses it is to be hoped that the system of printed papers, to be placed in the hands of members on the first day of the Congress, will be followed, and that abstracts only will be read at the sectional meetings. This plan, when adopted, leads to economy of time and to better discussions, and at an International Congress, where the proceedings are in three languages, it is demanded not only on these grounds, but also on that of mere comprehensibility. At the Berlin Congress which has just concluded, English was not well understood by a large proportion of the members, and the language barrier to intercourse and discussion was more apparent than one would have expected in an assembly of scientific men in the year 1903.

Prof. von Georgievics, at the Friday session of Section IV. of the Berlin Congress, has called attention to this question of printing all the papers before delivery by their authors, and the resolution passed on this subject by this section is to be submitted to the Congress Standing Committee.

The second point, which demands attention, relates to the acceptance or selection of papers by the Sectional Committees. Papers which are mere *rechauffés* of matter already published in the technical journals, or papers which are simply advertisements for the plant and apparatus of certain firms,

should be rigorously excluded from presentation to such congresses. Several papers of this kind were read at the sectional meetings which the writer attended in Berlin, and no doubt the exclusion of such papers is one of the difficulties attending the organisation of these International Congresses. Possibly, when the Congress is held in London in 1909, some way out of this difficulty will have been discovered; but it is safe to assert that, whatever alterations in the organisation of the Congress have then been made, it will be impossible to improve upon the capacity and efficiency shown by the President of the Fifth International Congress of Applied Chemistry, at Berlin—Prof. and Privy Councillor Otto N. Witt.

SOUTH AFRICAN NOTES.

(From our Special Correspondent at Johannesburg.)

June 8th, 1903.

Wellington.—A scheme of electric lighting for this municipality is now being discussed.

Kimberley.—It is understood in Kimberley that the De Beers Co. are negotiating with Messrs. Gibson Bros. with regard to the purchase of the Victoria Tramway, in order to have a service of electric trams throughout the town, and to Kenilworth, Wesselton, Alexandersfontein, West End, &c.

Beaconsfield, near Kimberley.—The Mayor of Beaconsfield has received a letter from the De Beers Co., informing him that the company undertake to light the streets of Beaconsfield with electricity free of charge, and will also supply energy for the Town Hall, and for municipal purposes on the same generous terms.

Cape Town.—In recognition of the grant made by the Municipal Council towards the South African College, the College Council has decided to call the new Chair of Engineering attached to the College by the title of the "Corporation Chair of Engineering."

The Electric and Waterworks Committee reported that they had given their careful consideration to the reference by the Council of paragraph No. 16 of the report of the Committee, submitted to the Council at their last meeting, with regard to the reorganisation of the staff of the electric light department in consequence of the resignation of Mr. Pflugstert. As the result, they recommended that Mr. Payne be appointed as station superintendent of the generating plant both at the central electric station in Dock Road, and the Molteno and Dorp Street stations, and, in consideration of the increased responsibility which will thus devolve upon Mr. Payne, that this gentleman be paid at the rate of £450 per annum, as from June 1st, 1903, it being understood that Mr. Payne will be entirely responsible to the electrical engineer for the efficient running and maintenance of the generating plant.

No objections having been lodged by the ratepayers or others interested in the proposed tram extension from Hanover Street through Windsor Street to the city boundary, the Special Court recommended the acceptance of the application on certain conditions.

Somerset Strand.—A public meeting of the ratepayers of this municipality was held last week to consider questions of public works. The scheme of the Lourens River and Estate Co., Ltd., to build and run a system of electric trams from S.S. Railway station to the town was fully dealt with, and received strong support.

Telegraphs.—Tenders are being invited for the loading up, conveyance and distribution of about 116,000 lbs. weight of telegraph material along the route of the proposed telegraph line between Umtata and Clarkebury.

Pretoria.—There are at present two kinds of telephone instruments in use in Pretoria, the "Burton" and "Ericsson;" much confusion and delay are caused thereby, and the authorities are contemplating entirely dispensing with the "Burton" and installing the "Ericsson" throughout.

Yeoville, Johannesburg.—The lighting question is being considered here.

BRITISH INDUSTRIES AND FOREIGN COMPETITION.

Speech by Mr. G. Byng (Chairman of the General Electric Co.) at the opening of the Robertson Lamp Works, June 26th.

I look upon the large attendance of ladies and gentlemen as an encouragement to British industries. There are a good many old friends amongst you, who have known me and the scope of our enterprises for a great many years, but there are a great many also to whom some introduction of myself and our undertakings would at the present moment be appropriate, and, at the outset, I wish to ask your kind indulgence if throughout my speech I refer a great deal to myself. Those who know me will readily understand that this is not done from any selfish motives, but mainly to draw from my own experience such lessons as cannot be found if I were to confine myself to generalities.

We manufacture almost every kind of electrical apparatus and machinery. At Birmingham we have our large works for dynamo, motor, carbon, steel tubing and electric light fitting. At Manchester we have our works for telephone, telegraph, bell, arc lamp, switchboard and electric light accessories. In the aggregate these works form the largest electrical undertaking in the country, and I, who am at the head of this enterprise, employ now more than 5,000 workpeople.

The following is a short history of the "Robertson" Electric Lamp Works:—

The late Mr. Fraser, our technical manager, Mr. Robertson, and myself, were the founders in 1893—10 years ago. The success of the works was slow at the beginning, but later on extension after extension became necessary, and the larger the works became the better and the cheaper could we produce our lamps. We commenced in the old building which you see here, then we bought the adjoining land, covering about an acre and a half, subsequently we built the fireproof building, then extension No. 1 and now the present extension No. 2.

We started here practically a new industry, and we ourselves taught the workpeople you see here, and not only those we now employ, but many more who have drifted elsewhere.

On the head of introducing a new industry into the country we may claim public credit. It is well known that on the system of free competition under which we have to work the starting of a new industry is almost an impossibility. If we are an exception, the reason lies mainly in the fact that we have two good men as managers—Mr. Robertson and Mr. Wilson—who have produced an electric lamp far superior to the lamps made by our foreign competitors. This has enabled us to obtain the goodwill and support of the British and Colonial electrical trade, amongst whom the "Robertson" lamp has become a household word, and the demand for the "Robertson" lamp has thereby not only increased, but we have been able to obtain a price not based upon competition alone, but on the merit of the article itself.

I do not mind confessing that it fills me with pride to stand in this position to-day, that of the founder of an enterprise, not only successful, but one that has done good to the country at large; but, proud as I am of this achievement, yet another feeling than pride fills me to-day, and this feeling is one of anxiety. I feel anxious for the safety of the child which I have reared. To-morrow circumstances may arise over which I have not the slightest control, which may pull down this whole edifice and bring the worry and work of years to nought. Do you think this is a comfortable position to be in? Now, in order to explain this, I come to the subject which is uppermost in the minds of most of us at the present moment. I refer to the question of preferential tariffs, which has been raised by Mr. Chamberlain. The matter is one which concerns manufacturers vitally, and upon which those who are employers of labour should be consulted, as they are the best able to speak from actual daily experience.

Would you plant a valuable tree in an exposed position where it can grow only in fair weather, but would perish by any wind that may come along? No, you would not. Look at this factory. As I have said, it is successful in fair weather; to-morrow it may be attacked, and in a year or two you may see it empty and deserted. I will explain.

I have told you that we have been successful, because we can make better goods than our foreign competitors. There is another reason. Manufacturers of incandescent lamps on the Continent have up till now quarrelled amongst themselves, and their power of competition in this country has been somewhat restricted, but they are beginning to combine. I can show you documentary evidence that a movement is on foot to combine all the German, Austrian and Dutch electric lamp factories, and what is their main object? It is first and foremost to kill the British industry of lamp making, and to capture the English market and that of our Colonies. And how will they do it? Not by any special invention or other meritorious achievement—no, first of all they will increase their price in their home market, thus becoming more powerful financially. This will mean increased output, and this open and undefended market is the place to get rid of that output.

I say this may happen in a few years' time—it may happen actually to-morrow. I am entirely powerless, helpless. The success of my enterprise, the investment of hundreds of thousands of pounds, the wages of my employés, the bread of my workmen depends upon the action, and is at the mercy, of the foreign manufacturers.

This is a dangerous position, one that cries for immediate relief. It is the duty of the State to provide policemen against burglars. It is the duty of the State to safeguard our industries against foreign attacks. We are in the midst of a fierce commercial war, and we are unarmed against the weapons of the whole world. This is how our present fiscal policy affects the master. How does it influence his workmen and their wages?

Here again I, an employer of labour, am entitled to be heard throughout the country, I hold that you should listen rather to the experience of a man who pays in wages alone over £6,000 per week, than rely upon the opinions of men who never pay wages but to their butler, coachman or cook.

Four principal factors determine the rates of wages of manufacturing workpeople—firstly, skill; secondly, competition; thirdly, profits of the master; fourthly, combination.

Re Skill of a Workman.—In the factory wherein you are at present the rates of wages vary from 8s. to £3 10s. per week. A girl who wraps up the parcels and is unskilled is paid 8s., but if she acquires the knowledge of glassblowing or air exhausting, she can command wages from two to four times as high. The same applies to the men; the ratio of their wages ranges in accordance with their

skill. Who teaches the workman? The master. What gives him the chance of becoming skilful? The enterprise of the master.

But I say emphatically, the system obtaining at present in our country, the uncertainty as to the security of capital invested, and the want of the home market wherein to sell, make it impossible for the master to be enterprising. I look forward with much concern to the future. If this system continues but a few years longer, the skill of an ordinary workman, as well as the inventive capacity of a higher-class workman, will be of necessity of a much lower standard than the skill of workpeople of other nations, and, of necessity, too, it will tend to reduce their wages.

Competition.—Again, take facts as occurring in this very factory. Here are those workpeople—glassblowers; look into their wages book. Two years ago their earnings averaged £3 a week; to-day they earn but 45s. per week. Six months ago our manager, Mr. Wilson, had to tell these men: "You have earned these high wages because we did not feel foreign competition. It is getting more formidable. We cannot sell at the old prices owing to foreign competition. You must either consent to have your wages reduced or go."

The English workman is exposed to the competition of the labour market of the whole world, and he cannot retaliate. Owing to circumstances which I could explain, he has not felt as yet the full force of this competition. I hope he never will; the result would startle even Sir Henry Campbell-Bannerman.

Profits of the Master.—This is obvious. If the master earns good profits he can pay good wages; if the profits are small, wages must go down. If there are no profits there will be no wages.

Those politicians who affirm that the workman pays no share to the income-tax (or direct taxation) may usefully ponder over this (apparently) schoolboy political economy.

Combination.—I am a believer in the usefulness of trade unions. I look upon them as a safety valve. We masters are human and not perfect. Trade unions keep us in order. But trade unions are powerless against foreign competition.

This is so obvious that I cannot understand at all the present attitude of those at the head of trade unions; they ought to be the first and foremost in the country to cry out to relieve them of that competition over which they at present have not the slightest control.

All these four factors are influenced by Free Trade, and in each one of them the outcome must ultimately be reduced wages. Give our workmen that protection which every other workman on the face of the globe possesses, and their wages must go up.

Mr. Chamberlain is right, and I emphatically endorse his contention. Do away with the self-inflicted incubus of one-sided Free Trade and wages will rise.

I say more. Give me and my workmen our legitimate share in our home and colonial markets, then not only will wages rise, but at the same time cost of production will go down. This statement of mine may sound a paradox to many who are anxious to continue the policy of doing nothing, but again I must claim to know more about what determines cost of production than people who never have produced 6d. worth in their lives.

I know well that many other considerations have to be reckoned with in this great question, but every one of them, without exception, must be secondary to this consideration: Will it harm or will it benefit the power of production of our people?

In conclusion, may I be so bold as to warn you against the assertions of men who have no practical experience.

I am certain that you will not find the true solution of what our country wants at this present critical juncture in the Blue-books of the House of Commons, or in the musty volumes of Adam Smith, Stuart Mill, or Ricardo; not even in the speeches of Cobden and Bright. No, the truth will be found here, only here, among the engineers who work machinery, among the chemists who ponder in our laboratories, among the clerks that reckon out the cost of production in our counting houses.

NEW PATENTS APPLIED FOR, 1903.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

13,311. "Protection for passengers, cars and general public against contact with overhead electric conduction wires through breaking away of same from supports." H. Fish. June 15th.

13,373. "An improved electro-magnetic chuck or work holder for machine tools." M. Margowski and C. Gorick. June 15th.

13,378. "Improvements in the method of constructing dynamo-electric generators." W. A. Johnson. June 15th. (Complete.)

13,394. "Improvements applicable for telephone and similar instruments." G. W. Möhrstadt and T. H. Gray. June 16th.

13,398. "Improvements in or appertaining to trolleys of electrically-propelled vehicles." G. C. Waters. June 16th.

13,486. "Improved circumferential grip terminal for electric cables." W. H. Simmonds. June 16th.

13,497. "Improvements in selective electrical signalling apparatus." J. E. Evans-Jackson. (American Electrical Telephone Co., United States.) June 16th.

13,502. "Improvements in and relating to the operating cords of the trolley arms of electric tramcars." A. Taylor, W. Moorhead and T. H. Kingscote. June 17th.

13,547. "Improvements in exciting and regulating alternating motors and alternators having collectors." A. Blondel. June 17th. (Date applied for under Patents Act, 1901, June 17th, 1902, being the date of application in Belgium.) (Complete.)

13,549. "Improvements in overhead bow collectors for electric traction." C. Higgs. June 17th.

13,570. "Improvements in electro-magnets for magnetic ore extractors." H. J. Haddan. (The Bergmann Electricitäts Werke, Aktiengesellschaft, Germany.) June 17th. (Complete.)

13,582. "Improved starting switch for electric motors." K. Ahlquist. June 18th.

13,590. "Improved metallic frictional blocks, such as brake-blocks, electrical collector slippers, and the like." T. Ashmore and P. McCullough. June 18th.

13,591. "An improvement in electrical collector and return slippers used in electrical traction." T. Ashmore and P. McCullough. June 18th.

13,628. "Improvement in electric alarms." M. Plato. June 18th.

13,682. "Improvements in and connected with electrolytic cells." H. Baker, A. T. Smith and the Castner-Kellner Alkali Co., Ltd. June 18th.

13,650. "Improvements relating to electrically-controlled workmen's time recorders and the like." J. J. Stockall, Jnr. June 18th.

13,674. "Improvements in electric selecting or selecting and signalling systems for communicating between a central, or main, or station and various other places, or sub-stations, and for performing various operations at such places or sub-stations." R. J. Sheehy and A. G. Curphey. June 18th. (Complete.)

13,692. "An improved electro-magnetic device, combined with a stop-watch, for recording accuracy in the measurement of time." Philip Harris & Co., Ltd., and S. Belcher. June 19th.

13,703. "A new or improved terminal for electrical connections, and method of making same." E. Liddle and G. E. Druiff. June 19th.

13,709. "Electric conduit railway." J. E. Parker. June 19th.

13,746. "Improved method for operating signals on electric railways. S. M. Young. June 19th.

13,750. "Improvements in and relating to depositing gold." W. Kington. June 20th.

13,799. "Improvements in systems for transforming single-phase alternating currents into mechanical driving power." E. Danielson. June 20th.

13,824. "Improvements in and relating to dynamo brushes." O. Siebers. June 20th.

PUBLISHED SPECIFICATIONS, 1902.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d (in stamps).

5,812. "Improvements in liquid resistances or switches for electrical purposes." J. H. Woollscroft. Dated March 8th.

6,149. "Improvements in automatic regulation of voltage in electric current systems." The British Thomson-Houston Co., Ltd., and H. S. Meyer. Dated March 12th.

6,396. "Magnetic contact box for electric railways." B. J. B. Mills. Dated March 15th.

6,654. "Improvements relating to electric switches." E. N. Bray. Dated March 18th.

7,152. "Improvements in systems of electrically controlling mechanism applicable to ships' steering gear, turrets, and the like." The British Thomson-Houston Co., Ltd. Dated March 24th. (Communicated.)

7,258. "An improvement in holders for electric glow lamps." H. H. Bence. Dated March 25th.

7,536. "An electric revolving brush for brushing the hair." A. E. Thomas. Dated March 29th.

7,684. "Improved electric light mechanism applicable for rapid exposure photography." A. J. Bonnella and D. H. Bonnella & Son, Ltd., and E. E. R. Bryant, C. H. Bryant and E. W. Bryant. Dated April 1st.

7,928. "An improvement in electrolytically coating iron with zinc." E. Goldberg. Dated April 4th.

7,988. "Improvements in splicing electric cables." A. D. Shuter. Dated April 4th.

7,957. "Improvements in electrical switches." The Electric and Ordnance Accessories Co., Ltd., and R. F. Hall. Dated April 5th.

8,396. "Improvements in troughs or conduits, more especially intended for underground electric cables." T. E. Devonshire. Dated April 10th.

8,414. "An improvement in or relating to holders for incandescent electric lamps." J. Oliver. Dated April 11th.

8,441. "An improved combined magneto-electric bell and indicator." A. Eckstein and A. Brooker. Dated April 11th.

8,775. "An electric ignition indicator for explosion engines, particularly applicable to motor-cars." T. W. Ellis. Dated April 15th.

9,062. "Improvements in connection with electric arc lamps." F. Gubing. Dated April 18th.

9,397. "Improvements in dynamo-electric machines." H. Chitty. Dated April 23rd.

9,721. "A new or improved high-tension electric condenser." A. Vasmaer and Dr. A. Lebnet. Dated April 26th.

9,982. "Improvements relating to the switches and conductors in stud contact systems of electric railways and tramways." E. Bede. Dated April 30th.

10,245. "Improvements in receivers suitable for wireless telegraphy." G. Marconi and Marconi's Wireless Telegraph Co. Dated May 3rd.

10,335. "Improvements in dynamo-electric machinery." A. H. Midgley. Dated March 5th.

11,079. "Improvements in cut-outs for electric conductors." The British Thomson-Houston Co., Ltd. Dated May 14th.

12,857. "Improvements in and relating to storage batteries." W. E. Winship. Dated June 5th.

14,507. "Improvements in controlling devices for electric motors." J. S. Highfield. Dated June 30th.

16,340. "Improvements in electrical selecting or individualising instruments." W. S. Burnett. Dated March 5th.

16,843. "Improvements in and relating to clocks, and particularly to electric clocks." J. Butcher. Dated July 22nd.

17,994. "Improvements in electric interrupters." L. G. Nilson. Dated May 14th.

17,995. "Improvements in driving mechanism for electric road vehicles." L. G. Nilson. Dated May 14th.

17,997 "Improvements in controllers for electric motors." L. G. Nilson. Dated May 15th.

17,998. "Improvements in electric-gasoline vehicles." L. G. Nilson. Dated May 15.

19,128. "An improved electric heater or radiator." E. G. Rivers. Dated September 1st.

19,522. "Improvements in electric heating stoves." Veritys, Ltd., and P. G. Ebutt. Dated September 6th.

20,280. "Electrical insulator." M. Harlve. Dated September 17th.

21,019. "Improvements in connection with submarine or other vessels, torpedoes, and the like for controlling and operating them by electricity." L. Wilson. Dated September 26th.

22,750. "Improvements relating to electric illuminating devices, chiefly designed for use in connection with signs or the like, on tramway and other vehicles." H. H. Lake. (Reversible Electric Car Sign Co., U.S.A.) Dated October 18th.